NASA

Earth Resources
A Continuing Bibliography with Indexes

NASA SP-7041 (32)
January 1982

National Aeronautics and Space Administration

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ACCESSION NUMBER RANGES

Accession numbers cited in this Supplement fall within the following ranges:

IAA (A-10000 Series)	A81-40833 – A81-49982
STAR (N-10000 Series)	N81-28047 – N81-34139

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NASA SP-7041 (32)

EARTH RESOURCES

A Continuing Bibliography
With Indexes
Issue 32

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system and announced between October 1 and December 31, 1981 in

- *Scientific and Technical Aerospace Reports (STAR)*
- *International Aerospace Abstracts (IAA).*

NASA Scientific and Technical Information Branch 1982
National Aeronautics and Space Administration
Washington, DC

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INTRODUCTION

The technical literature described in this continuing bibliography may be helpful to researchers in numerous disciplines such as agriculture and forestry, geography and cartography, geology and mining, oceanography and fishing, environmental control, and many others. Until recently it was impossible for anyone to examine more than a minute fraction of the earth's surface continuously. Now vast areas can be observed synoptically, and changes noted in both the earth's lands and waters, by sensing instrumention on orbiting spacecraft or on aircraft.

This literature survey lists 580 reports, articles, and other documents announced between October 1 and December 31, 1981 in *Scientific and Technical Aerospace Reports (STAR)*, and *International Aerospace Abstracts (IAA)*.

The coverage includes documents related to the identification and evaluation by means of sensors in spacecraft and aircraft of vegetation, minerals, and other natural resources, and the techniques and potentialities of surveying and keeping up-to-date inventories of such riches. It encompasses studies of such natural phenomena as earthquakes, volcanoes, ocean currents, and magnetic fields; and such cultural phenomena as cities, transportation networks, and irrigation systems. Descriptions of the components and use of remote sensing and geophysical instrumentation, their subsystems, observational procedures, signature and analyses and interpretive techniques for gathering data are also included. All reports generated under NASA's Earth Resources Survey Program for the time period covered in this bibliography will also be included. The bibliography does not contain citations to documents dealing mainly with satellites or satellite equipment used in navigation or communication systems, nor with instrumentation not used aboard aerospace vehicles.

The selected items are grouped in nine categories. These are listed in the Table of Contents with notes regarding the scope of each category. These categories were especially chosen for this publication, and differ from those found in *STAR* and *IAA*.

Each entry consists of a standard bibliographic citation accompanied by an abstract. The citations and abstracts are reproduced exactly as they appeared originally in *STAR*, or *IAA*, including the original accession numbers from the respective announcement journals. This procedure, which saves time and money, accounts for the variation in citation appearance.

Under each of the nine categories, the entries are presented in one of two groups that appear in the following order:

IAA entries identified by accession number series A81-10,000 in ascending accession number order;

STAR entries identified by accession number series N81-10,000 in ascending accession number order.

After the abstract section, there are five indexes:

subject, personal author, corporate source, contract number and report/accession number.

AVAILABILITY OF CITED PUBLICATIONS

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All publications abstracted in this Section are available from the Technical Information Service, American Institute of Aeronautics and Astronautics, Inc. (AIAA), as follows: Paper copies of accessions are available at $7.00 per document up to a maximum of 40 pages. The charge for each additional page is $0.25. Microfiche [1] of documents announced in *IAA* are available at the rate of $3.00 per microfiche on demand, and at the rate of $1.25 per microfiche for standing orders for all *IAA* microfiche. The price for the *IAA* microfiche by category is available at the rate of $1.50 per microfiche plus a $1.00 service charge per category per issue. Microfiche of all the current AIAA Meeting Papers are available on a standing order basis at the rate of $1.50 per microfiche.

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TABLE OF CONTENTS

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Abstracts in this Bibliography are grouped under the following categories: *page:*

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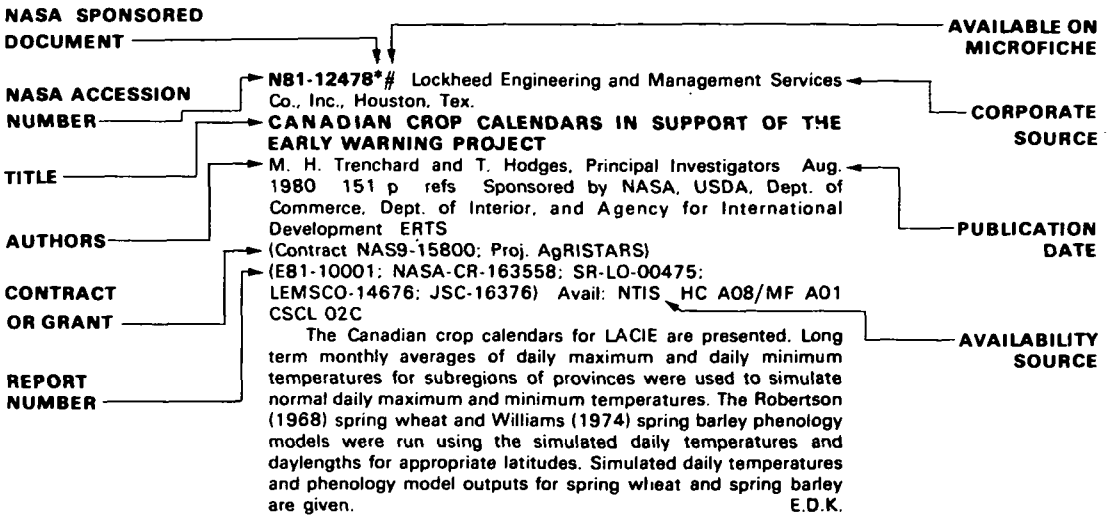

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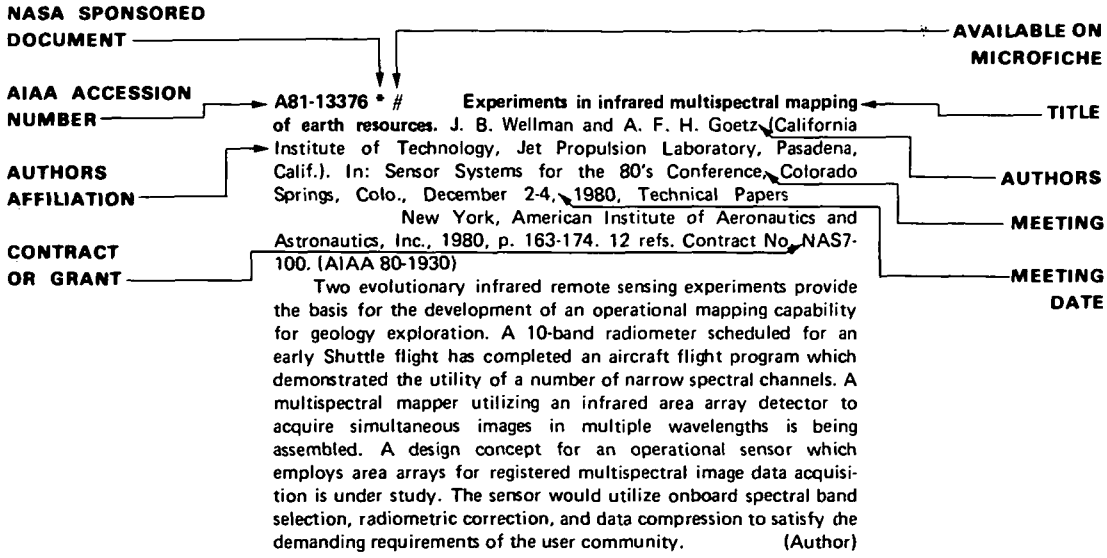

EARTH RESOURCES

A Continuing Bibliography (Issue 32)

JANUARY 1982

01
AGRICULTURE AND FORESTRY

Include crop forecasts, crop signature analysis, soil identification, disease detection, harvest estimates, range resources, timber inventory, forest fire detection, and wildlife migration patterns.

A81-41485 # **Results of ground surveys, carried out in conjunction with satellite and aerial studies, of the state of winter wheat on the Kursk test polygon (Rezul'taty nazemnykh podsputnikovykh i podsamoletnykh issledovanii sostoianiia ozimoi pshenitsy na testovom uchastke Kurskogo poligona).** N. V. Beliaeva and T. M. Vasiukhina. In: Some results on the investigation of earth resources by aerial and polygon methods. Leningrad, Gidrometeoizdat, 1980, p. 51-63. 12 refs. In Russian.

A81-41486 # **Determination of the types and state of crops from multispectral aerial photographs (Opredelenie vidov i sostoianiia sel'skokhoziaistvennykh kul'tur po materialam mnogozonal'noi aerofotos'emki).** T. M. Vasiukhina and N. K. Vinnichenko. In: Some results on the investigation of earth resources by aerial and polygon methods. Leningrad, Gidrometeoizdat, 1980, p. 64-72. 5 refs. In Russian.

A81-41487 # **Evaluation of the possibility of using spectral-band and multispectral aerial photographs for the large-scale survey of natural pastures (Otsenka vozmozhnosti ispol'zovaniia spektrozonal'nykh i mnogozonal'nykh aerofotosnimkov dlia krupnomasshtabnogo obsledovaniia prirodnykh kormovykh ugodii).** N. V. Beliaeva, V. B. Golub, and E. V. Tsvetaeva. In: Some results on the investigation of earth resources by aerial and polygon methods. Leningrad, Gidrometeoizdat, 1980, p. 73-79. 7 refs. In Russian.

A81-41488 # **The possibilities of the automated classification of agricultural objects on the basis of their multispectral aerial-spaceborne images (Vozmozhnosti avtomatizirovannoi klassifikatsii sel'skokhoziaistvennykh ob'ektov po ikh mnogozonal'nym aerokosmicheskim izobrazheniiam).** G. G. Andreev. In: Some results on the investigation of earth resources by aerial and polygon methods. Leningrad, Gidrometeoizdat, 1980, p. 80-85. 5 refs. In Russian.

The paper examines software aspects of the automated processing of aerial and spaceborne images of agricultural regions; the purpose of the processing is to classify agricultural objects on the basis of their photometric features and to identify these objects with crops. Particular attention is given to a method that involves the use of a chain of recognition algorithms. Applications of this method are considered. B.J.

A81-41489 # **Practical application of the method of empty blocks for the computerized determination of the boundaries of agricultural objects (Prakticheskoe primenenie metoda pustykh blokov dlia vydeleniia granits sel'skokhoziaistvennykh ob'ektov s pomoshch'iu EVM).** G. G. Andreev and L. N. Choban. In: Some results on the investigation of earth resources by aerial and polygon methods. Leningrad, Gidrometeoizdat, 1980, p. 86-92. In Russian.

An important problem in the machine analysis of multispectral images of agricultural objects is the determination of the boundaries of these objects. The criterion of empty blocks (a method for verifying nonparametric statistical hypotheses) is proposed as a method for determining these boundaries. Algorithms of the main program and the learning program are presented along with examples of computation on the EC-1022 computer. B.J.

A81-43181 **Agricultures's needs related to satellite hydrology.** E. T. Engman (U.S. Department of Agriculture, Hydrology Laboratory, Beltsville, MD). In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979. Minneapolis, MN, American Water Resources Association, 1981, p. 19-25. 10 refs.

A81-43221 * **Survey of in-situ and remote sensing methods for soil moisture determination.** T. J. Schmugge (NASA, Goddard Space Flight Center, Laboratory for Atmospheric Sciences, Greenbelt, MD), T. J. Jackson (U.S. Department of Agriculture, Hydrology Laboratory, Beltsville, MD), and H. L. McKim (U.S. Army, Cold Regions Research Engineering Laboratory, Hanover, NH). In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979. Minneapolis, MN, American Water Resources Association, 1981, p. 333-352. 152 refs.

General methods for determining the moisture content in the surface layers of the soil based on in situ or point measurements, soil water models and remote sensing observations are surveyed. In situ methods described include gravimetric techniques, nuclear techniques based on neutron scattering or gamma-ray attenuation, electromagnetic techniques, tensiometric techniques and hygrometric techniques. Soil water models based on column mass balance treat soil moisture contents as a result of meteorological inputs (precipitation, runoff, subsurface flow) and demands (evaporation, transpiration, percolation). The remote sensing approaches are based on measurements of the diurnal range of surface temperature and the crop canopy temperature in the thermal infrared, measurements of the radar backscattering coefficient in the microwave region, and measurements of microwave emission or brightness temperature. Advantages and disadvantages of the various methods are pointed out, and it is concluded that a successful monitoring system must incorporate all of the approaches considered. A.L.W.

A81-43224 * **Soil moisture applications of the heat capacity mapping mission.** J. L. Heilman (Texas A&M University, College Station, TX) and D. G. Moore (South Dakota State University, Brookings, SD). In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979. Minneapolis, MN, American Water Resources Association, 1981, p. 371-376. 5 refs. Contract No. NAS5-2406.

Results are presented of ground, aircraft and satellite investigations conducted to evaluate the potential of the Heat Capacity Mapping Mission (HCMM) to monitor soil moisture and the depth of shallow ground water. The investigations were carried out over eastern South Dakota to evaluate the relation between directly measured soil temperatures and water content at various stages of canopy development, aircraft thermal scanner measurements of

RICULTURE AND FORESTRY

t canopy temperature and the reliability of actual HCMM
The results demonstrate the possibility of evaluating soil
re on the basis of HCMM apparent canopy temperature and
ght soil temperature difference measurements. Limitations on
se of thermal data posed by environmental factors which
ence energy balance interactions, including phase transforma-
, wind patterns, topographic variations and atmospheric constit-
ts are pointed out. A.L.W.

31-43262 **A multistage mapping approach for an irri-**
ated croplands inventory. L. Tinney, J. Holloway, J. Baggett, and J.
stes (California, University, Santa Barbara, CA). In: Satellite
ydrology; Proceedings of the Fifth Annual William T. Pecora
Memorial Symposium on Remote Sensing, Sioux Falls, SD, June
10-15, 1979. Minneapolis, MN, American Water
Resources Association, 1981, p. 694-696.

A81-43264 **Selected irrigation acreage estimates in north-**
ern Florida from Landsat data. K. B. Webster, R. J. Musgrove
(Suwannee River Water Management District, White Springs, FL), J.
R. Lucas (Technicolor Graphic Services, Inc.; U.S. Geological Survey,
EROS Data Center, Sioux Falls, SD), and A. L. Higer (U.S.
Geological Survey, Miami, FL). In: Satellite hydrology; Proceedings
of the Fifth Annual William T. Pecora Memorial Symposium on
Remote Sensing, Sioux Falls, SD, June 10-15, 1979.
Minneapolis, MN, American Water Resources Association, 1981,
p. 701-705. Research supported by the U.S. Geological Survey.

A81-43265 * **Mapping irrigated lands in Western Kansas**
from Landsat. T. H. L. Williams and J. Poracsky (Kansas, University,
Lawrence, KS). In: Satellite hydrology; Proceedings of the Fifth
Annual William T. Pecora Memorial Symposium on Remote Sensing,
Sioux Falls, SD, June 10-15, 1979. Minneapolis,
MN, American Water Resources Association, 1981, p. 707-714. 19
refs. Grant No. NGL-17-004-024.

A description is presented of a multidate visual interpretation
technique for identifying and mapping irrigated lands in Western
Kansas based on gray tone interpretation of Landsat imagery. The
technique provides detailed maps of irrigated lands that can be
updated yearly (from 1972 onwards) and used as the basis for
calculations of water use and its temporal trends. A review of remote
sensing work on irrigated lands indicates that three different types of
study have evolved, involving various combinations of desired final
data and the means of arriving at it. Attention is given to crop
characteristics, the development of an interpretation technique, the
interpretation procedure, the computer assisted output, and aspects
of verification and accuracy. It is pointed out that the considered
technique is likely to be applicable to similar situations of a semi-arid
area dominated by a small number of crops. G.R.

A81-43266 **Mapping irrigated cropland on the High Plains**
using Landsat. G. P. Thelin, T. L. Johnson, and R. A. Johnson (U.S.
Geological Survey, Reston, VA). In: Satellite hydrology; Proceedings
of the Fifth Annual William T. Pecora Memorial Symposium on
Remote Sensing, Sioux Falls, SD, June 10-15, 1979.
Minneapolis, MN, American Water Resources Associa-
tion, 1981, p. 715-721.

A program has been recently undertaken to determine water use
in the High Plains. The High Plains aquifer, the focus of the study,
covers approximately 450,000 square kilometers. The study, called
the High Plains Regional Aquifer-System Analysis is developing a
computer model designed to simulate the ground water system
throughout the High Plains aquifer. Three difference methods for
mapping irrigated cropland were evaluated. The first method
employed visual interpretation of classified source materials. The
second method employs interpretation of Landsat multispectral
images, and the third the digital analysis of Landsat data. It was
found that digital analysis of Landsat multispectral data provides an
efficient method of mapping irrigated cropland. After evaluating the
three different methods for mapping the areal extent of irrigated
cropland, plans are being made to complete the task of mapping for
the entire extent of the High Plains Regional aquifer. G.R.

A81-43536 **Rainforest species on large-scale color photos.**
B. J. Myers and M. L. Benson (Commonwealth Scientific and
Industrial Research Organization, Div. of Forest Research, Canberra,
Australia). *Photogrammetric Engineering and Remote Sensing*, vol.
47, Apr. 1981, p. 505-513. 16 refs.

The extreme variability and complexity of tropical rainforests
preclude any detailed floristic classification from conventional
small-scale black-and-white aerial photographs. This paper describes a
study conducted in north Queensland of the use of large-scale color,
color infrared, and black-and-white aerial photographs for the
identification of tree species as a basis for rainforest classification.
Normal color transparency film at 1:2000 scale was the best
combination of film and scale for species identification. Six forest
areas studied by five interpreters had a total of 111 different
dominant and codominant species. In the test stands, 55 different
rainforest species were correctly identified at least once. Twenty-four
species were identified with more than 75 percent accuracy and 11
of these were correctly identified in every case examined by the five
interpreters. Directions for future research are suggested. (Author)

A81-43537 **Extravisual damage detection - Defining the**
standard normal tree. P. A. Murtha and J. A. McLean (British
Columbia, University, Vancouver, Canada). *Photogrammetric Engi-
neering and Remote Sensing*, vol. 47, Apr. 1981, p. 515-522. 9 refs.
Research supported by the Natural Sciences and Engineering
Research Council of Canada.

Large-scale color-infrared aerial photographs of an interior
British Columbia Douglas-fir stand are examined by optical visual
analysis techniques for evidence of tree damage. Red-, green-, and
blue-filter optical densitometric measurements were taken from
developed film dye-layers, and the red:green-, red:blue-, and
green:blue-filter density ratios were calculated. Damages were classi-
fied according to type, and the trees were field-checked for accuracy
of species designation, height, age, and other pathological conditions.
Results of a diameter increment analysis indicated that diameter
increments were related to damage classification, with damage type
III Ob having a reduced radial increment of less than 0.05. Damage
types III Oa and III Ob had darker or lighter magenta hues than
neighboring normal trees, although they could not be separated
visually by crown characteristics. Selective logging makes desirable
the removal of slow growing trees, and this technique makes possible
the thinning of damage type III Ob and III Ob/II E trees for selective
logging programs. D.L.G.

A81-43540 * **Vegetable crop management with remote sens-**
ing. C. H. Blazquez (NASA, Kennedy Space Center, Cocoa Beach,
FL), R. A. Elliott (Systems Control, Inc., Vt, Champlain Technolo-
gy Industries, West Palm Beach, FL), and G. J. Edwards (Florida,
University, Lake Alfred, FL). *Photogrammetric Engineering and
Remote Sensing*, vol. 47, Apr. 1981, p. 543-547. 12 refs.

Repetitive aerial photography with color infrared (ACIR) and
black-and-white infrared IB and WIR) films was taken of potato and
tomato fields in southwest Florida during the spring season of 1975.
Color differences observed in the photographs revealed different
levels of soil moisture in the fields, improper ditch arrangements,
poor stands of plants, and areas where late blight (Phytophthora
infestans) (Mont.)d.By and early blight (Alternaria solani) (El. and
Mart.) Jones and Grout. were defoliating potato plants. Photographs
of fields before planting also indicated areas where excessive rock
formations existed which would make field preparation costly
Preplanting photographs also pinpointed areas with different wate
table levels. (Autho

A81-43727 **Rainbow 80; Fall Technical Meeting, Nia**
Falls, NY, October 7-10, 1980, ASP Technical Papers. Me
sponsored by the American Society of Photogrammetry and A
can Congress on Surveying and Mapping. Falls Church VA, Am
Society of Photogrammetry, 1981. 358 p.

Topics discussed include new uses of photogrammetr
niques, current digital processing for interfacing cartograp
photogrammetry and land remote sensing and data ac
Particular consideration is given to remote sensing and plar
applications, such as the use of remote sensing data in
vegetative variables, detecting crop stress, and interpretin
patterns. Imaging radar used in geology, hydrospherics, a
mental impact assessment are also discussed.

A81-43732 Mountain pine beetle damage surveys with high-altitude panoramic photography. B. B. Eav, R. D. Dillman, J. C. Prill, and R. E. Hinkle (Lockheed Engineering and Management Services Co., Inc., Houston, TX). In: Rainbow 80; Fall Technical Meeting, Niagara Falls, NY, October 7-10, 1980, ASP Technical Papers. Falls Church, VA, American Society of Photogrammetry, 1981, p. DA-1-D-1 to DA-1-D-14. 10 refs. U.S. Department of Agriculture Contract No. 53-3187-8-25.

An investigation of the potential of high altitude panoramic photography obtained with Itek KA-80A optical bar camera, compared with conventional surveys, for improving the efficiency of statewide mountain pine beetle (Dendroctonus ponderosa Hopkins) damage assessment involved the development of an appropriate survey design. The survey design initially developed for a small scale test using data from the Black Hills National Forest in South Dakota was a two-stage sampling with probability proportional to size in each stage. This design was refined and modified to include a third stage for application on a large scale in the Colorado Front Range comprising 5.5 million acres. Results indicate that optical bar surveys are a realistic alternative to conventional survey techniques and potentially more cost effective. (Author)

A81-43737 The effect of sensor bandpass and spectral response in crop stress detection. M. J. Duggin (New York, State University, Syracuse, NY) and P. N. Slater (Arizona, University, Tucson, AZ). In: Rainbow 80; Fall Technical Meeting, Niagara Falls, NY, October 7-10, 1980, ASP Technical Papers.
Falls Church, VA, American Society of Photogrammetry, 1981, p. RS-2-C-1 to RS-2-C-12. 8 refs. Research supported by the U.S. Department of Agriculture and New York State Department of Environmental Conservation.

In order to map and to quantify vegetative disease using remote sensing it is necessary to be able to analyze the data to discern contrasts between healthy and diseased vegetative canopies, or between canopies affected by disease to different levels of severity. In order to perform such quantitative analysis, it is necessary to consider the interaction between the spectral reflectance of the target and the spectral response of the remote sensing device. While such interaction will be small for spectrally flat targets (e.g. white sand), they have been found to be larger for vegetation. Calculations are made to compare the contrasts obtained by using the outputs of each channel within each band of the Landsat multispectral scanners (MSS's) when looking at identical pairs of vegetative targets. Similar calculations are performed for Kodak color-infrared film (EK 2448) and for Kodak black-and-white infrared film (EK 2424). (Author)

A81-43738 * Waveband evaluation of proposed thematic mapper in forest cover classification. R. S. Latty and R. M. Hoffer (Purdue University, West Lafayette, IN). In: Rainbow 80; Fall Technical Meeting, Niagara Falls, NY, October 7-10, 1980, ASP Technical Papers. Falls Church, VA, American Society of Photogrammetry, 1981, p. RS-2-D-1 to RS-2-D-12. 31 refs. Contract No. NAS9-15889.

This study involved the evaluation of the characteristics of multispectral scanner data relative to forest cover type mapping, using NASA's NS-001 multispectral scanner to simulate the proposed Thematic Mapper (TM). The objectives were to determine: (1) the optimum number of wavebands to utilize in computer classifications of TM data; (2) which channel combinations provide the highest expected classification accuracy; and (3) the relative merit of each channel in the context of the cover classes examined. Transformed divergence was used as a measure of statistical distance between spectral class densities associated with each of twelve cover classes. The maximum overall mean pair-wise transformed divergence was used as the basis for evaluating all possible waveband combinations available for use in computer-assisted forest cover classifications. (Author)

A81-43740 * Remote sensing aided procedure for conifer growth modeling in the northeastern Sierra Nevada. H. G. Smith and S. Khorram (California, University, Berkeley, CA). In: Rainbow 80; Fall Technical Meeting, Niagara Falls, NY, October 7-10, 1980, ASP Technical Papers. Falls Church, VA, American Society of Photogrammetry, 1981, p. RS-2-F-1 to RS-2-F-13. 10 refs. Grant No. NGL-05-003-404.

The objective of this study was to use remotely-sensed data with ground-acquired data for preparing inputs to a mathematical model for generation of a potential conifer growth map of a wildland area. The study area, jointly selected by the resource managers of the U.S. Forest Service at the Plumas National Forest and researchers, covers approximately 500 sq km in the northeastern scrapment of Sierra Nevada. The approach involved a computerized databank based on both remotely-sensed and ground-acquired data. The remotely-sensed data included Landsat Multispectral Scanner (MSS) data, NOAA-5 Very High Resolution Radiometer (VHRR) data and U-2 Color infrared photography. The ground data included U.S. Geological Survey (USGS) topographic maps, Defense Mapping Agency (DMA)/ USGS digital terrain data, soil maps, and vegetation data. The results included a series of maps for the final product as well as the intermediate products. The intermediate products were potential evapotranspiration, aspect, and soil plant available water. (Author)

A81-43741 * Look direction dependence of radar backscattering cross section for agricultural fields. W. P. Waite, H. C. MacDonald, J. S. Demarcke, and B. H. Corbell (Arkansas, University, Fayetteville, AR). In: Rainbow 80; Fall Technical Meeting, Niagara Falls, NY, October 7-10, 1980, ASP Technical Papers.
Falls Church, VA, American Society of Photogrammetry, 1981, p. RS-2-G-1 to RS-2-G-14. 9 refs. Contracts No. NAS9-14251; No. JPL-954940.

Analysis of multifrequency-multipolarization scatterometer data acquired by NASA Johnson Space Center during the 1978 Colby Agricultural Soil Moisture Experiment provides evidence that the effects of row orientation remain quite severe for relatively bare fields over a wide range of radar frequencies. In addition, Seasat satellite radar imagery from areas in Louisiana shows dominant row orientation effects even beneath substantial amounts of vegetation cover. The multiparameter nature of the Colby data set, and the continuous angular change in field patterns observed in the Louisiana test area provide much finer definition of microwave sensitivity to row orientation than has been possible in the past. (Author)

A81-43743 * Use of Seasat satellite radar imagery for the detection of standing water beneath forest vegetation. H. C. MacDonald, W. P. Waite, and J. S. Demarcke (Arkansas, University, Fayetteville, AR). In: Rainbow 80; Fall Technical Meeting, Niagara Falls, NY, October 7-10, 1980, ASP Technical Papers.
Falls Church, VA, American Society of Photogrammetry, 1981, p. RS-3-B-1 to RS-3-B-13. 13 refs. Contract No. JPL-954940.

The Seasat synthetic aperture radar, operating at a 23-cm, L-band wavelength, detected anomalous tonal patterns in areas having relatively uniform vegetable canopy. These anomalously high radar returns were shown to be related more to the underlying terrain (areas of standing water) than to the vegetation canopy. These results show that L-band radars, imaging forested terrain in a Seasat configuration, are sensitive to gross changes in vegetation, and may even penetrate the vegetation canopy, providing an unmistakable radar signature. Properly designed space imaging radar shuttle experiments, using multiple frequency and polarization radars of various depression angles, may provide documentation for a flood-monitoring capability. Height, configuration, and density of the biomass in conjunction with frequency and incidence angle of the imaging system are shown to be important factors in formulating a backscatter model, but the relative significance of each is yet to be determined. J.F.

A81-43744 * Active microwave measurements for estimating soil moisture in Oklahoma. T. J. Jackson (U.S. Department of Agriculture, Hydrology Laboratory, Beltsville, MD), A. Chang, and T. J. Schmugge (NASA, Goddard Space Flight Center, Greenbelt, MD). In: Rainbow 80; Fall Technical Meeting, Niagara Falls, NY, October 7-10, 1980, ASP Technical Papers. Falls Church, VA, American Society of Photogrammetry, 1981, p. RS-3-C-1 to RS-3-C-10. 8 refs.

Previous research has shown that active and passive microwave sensors can be used to estimate near surface soil moisture. An advantage of the active systems is that they have the capability of high spatial resolution from satellite platforms. Most of the previous research has been conducted on agricultural fields. This study examined the use of active microwave data for estimating the average

surface soil moisture for several watersheds located near Chicasha, Oklahoma. Data were collected using P, L, and C band scatterometers, mounted on the National Aeronautics and Space Administration C130B aircraft flying at an altitude of 300 m. Soil moisture data were collected in conjunction with three flights during May 1978. Our results indicated that relationships between the scatterometer data and soil moisture do exist and agree with the results obtained at the University of Kansas. (Author)

A81-44637 Crop reporting from space - Problems, promises, potential. D. Paarlberg. In: Commercial operations in space - 1980-2000; Proceedings of the Eighteenth Goddard Memorial Symposium, Washington, DC, March 27, 28, 1980. San Diego, CA, American Astronautical Society; Univelt, Inc., 1981, p. 111-115. (AAS 80-062)

Crop reporting from space is in a transitional stage, gradually becoming operational. Research, experimentation and development continue. A three-year experimental program marginally met its target for accuracy with regard to wheat production in the USSR, 90 percent accurate 90 percent of the time. Remote sensing is being used by the Department of Agriculture to improve the accuracy of its crop reports in the United States. It has not been possible to estimate costs and benefits with acceptable accuracy. The best method of releasing remote-sensed crop report data seems to be wide simultaneous distribution to the general public, free of direct cost. (Author)

A81-45428 A photo interpretation approach to forest regrowth monitoring using side-looking airborne radar - Grant County, Oregon. N. E. Hardy (Toronto, University, Mississauga, Ontario, Canada). *International Journal of Remote Sensing,* vol. 2, Apr.-June 1981, p. 135-144. 11 refs.

A preliminary project was devised to study the forest monitoring potential of side-looking airborne radar. A group of ten photo interpreters was assembled to evaluate the forest regrowth content of a radar image. A series of 20 cutting locations was selected from U.S. Forest Service data. Categories and category associations were tabulated from each participant's results. Some success was achieved in distinguishing between five major forest categories. Little success was achieved in attempting to subdivide the image content into highly specific categories. It was concluded that the radar has the potential to segregate categories, but interpreters must possess as much radar interpretation expertise as forestry expertise. (Author)

A81-45432 * Infrared-temperature variability in a large agricultural field. J. P. Millard (NASA, Ames Research Center, Moffett Field, CA), R. C. Goettelman (EAL Corp., Richmond, CA), and M. J. LeRoy (DCA Corp., Palo Alto, CA). *International Journal of Remote Sensing,* vol. 2, July-Sept. 1981, p. 201-211.

Dunnigan Agro-Meteorological Experiment airborne thermal scanner images of a large varying-terrain barley field are acquired and analyzed. Temperature variability that may occur within instantaneous fields of view (IFOV) is defined (coefficient of variation: standard deviation/mean temperature in degrees C), and the percentage of the area within various IFOV's within + or - 1, 2, 3, and 5 degrees of the mean is determined. With the exception of very rugged terrain, over 80% of the area within 4, 16, 65 and 258 ha cells was at temperatures within + or - 3 C of the mean cell temperature. Remote measurements of field temperature appeared to be slightly influenced by pixel size in the range 4 ha to 259 ha, and the area percentage within any pixel which contributes within + or - 1, 2, 3, and 5 degrees C of the mean, is nominally the same. In conclusion, no great advantage is found in utilizing a small IFOV instead of a large one for remote sensing of crop temperature. D.L.G.

A81-46026 Machine processing of remotely sensed data and soil information systems and remote sensing and soil survey; Proceedings of the Sixth Annual Symposium, Purdue University, West Lafayette, IN, June 3-6, 1980. Symposium sponsored by the International Society of Soil Science, American Society of Agronomy, IEEE, et al. Edited by P. G. Burroff and D. B. Morrison. New York, Institute of Electrical and Electronics Engineers, Inc., 1980. 397 p. Members, $22.50; nonmembers, $30.

Papers included in this volume cover the general areas of data processing and analysis, data processing systems, crop inventory, forestry, land use, soil survey, and soil information. The following topics are discussed: the current and future need for land resource information, future earth resource data acquisition systems, current soil information systems, remote sensing and soil survey, and the future requirements of resource data storage, retrieval, analysis, and utilization. Plans for the U.S. operational land satellite program, soil information needs, nonfederal information requirements, and research priorities for the 1980's are outlined. V.L.

A81-46031 Application of multispectral reflectance studies of soils - Pre-Landsat. S. J. Kristof, M. F. Baumgardner, R. A. Weismiller, and S. Davis (Purdue University, West Lafayette, IN). In: Machine processing of remotely sensed data and soil information systems and remote sensing and soil survey; Proceedings of the Sixth Annual Symposium, West Lafayette, IN, June 3-6, 1980. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 52-62. 12 refs.

Results of preliminary studies on the reflectance properties of soils as related to their other physical and chemical properties are presented. Laboratory studies of the spectral properties of 250 soil samples representing 22 soil series, ten textures, and four drainage profiles were carried out to determine the visible and infrared spectral bands most suitable for observing soil variations. The application of the digital analysis of multispectral data to soil mapping was then studied on the basis of double-beam spectrophotometer and airborne multispectral scanner data taken of ten areas characterized by vegetation, bare soil and water features. Analysis of the field data confirmed the relationships found between soil reflectance and color, organic matter content, moisture content and texture, and indicated the usefulness of multispectral mapping in soil surveys. A.L.W.

A81-46032 * An assessment of Landsat data acquisition history on identification and area estimation of corn and soybeans. M. M. Hixson, M. E. Bauer (Purdue University, West Lafayette, IN), and D. K. Scholz (U.S. Geological Survey, EROS Data Center, Sioux Falls, SD). In: Machine processing of remotely sensed data and soil information systems and remote sensing and soil survey; Proceedings of the Sixth Annual Symposium, West Lafayette, IN, June 3-6, 1980. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 72-77. 9 refs. Contract No. NAS9-15466.

During the past decade, numerous studies have demonstrated the potential of satellite remote sensing for providing accurate and timely crop area information. This study assessed the impact of Landsat data acquisition history on classification and area estimation accuracy of corn and soybeans. Multitemporally registered Landsat MSS data from four acquisitions during the 1978 growing season were used in classification of eight sample segments in the U.S. Corn Belt. The results illustrate the importance of selecting Landsat acquisitions based on spectral differences in crops at certain growth stages. (Author)

A81-46033 * Crop classification with a Landsat/radar sensor combination. R. Y. Li, F. T. Ulaby (University of Kansas Center for Research, Inc., Lawrence, KS), and J. R. Eyton (South Carolina, University, Columbia, SC). In: Machine processing of remotely sensed data and soil information systems and remote sensing and soil survey; Proceedings of the Sixth Annual Symposium, West Lafayette, IN, June 3-6, 1980. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 78-87. 9 refs. Contract No. NAS9-15421.

A combined Landsat/radar approach to classification of remotely sensed data, with emphasis on crops, was undertaken. Radar data were obtained by microwave radar spectrometers over fields near Eudora, Kansas and Landsat image data were obtained for the same test site. After Landsat digital images were registered and test-cells extracted, a comparable set of radar image pixels were simulated to match the Landsat pixels. The combined data set is then used for classification, and the results are examined with the best combination of sensor variables identified. Finally, the usefulness of radar in a simulated cloud-cover situation is demonstrated. The major conclusion derived from this study is that the combination of radar/optical sensors is superior to either one alone. (Author)

A81-46034 # Comparison of Landsat-2 and field spectrometer reflectance signatures of south Texas rangeland plant communities. A. J. Richardson, D. E. Escobar, H. W. Gausman, and J. H. Everitt (U.S. Science and Education Administration, Weslaco, TX). In: Machine processing of remotely sensed data and soil information systems and remote sensing and soil survey; Proceedings of the Sixth Annual Symposium, West Lafayette, IN, June 3-6, 1980. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 88-97. 27 refs.

A81-46035 * A model of plant canopy polarization response. V. C. Vanderbilt (Purdue University, West Lafayette, IN). In: Machine processing of remotely sensed data and soil information systems and remote sensing and soil survey; Proceedings of the Sixth Annual Symposium, West Lafayette, IN, June 3-6, 1980. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 98-108. 30 refs. Contract No. NAS9-15466.

Sensors to remotely measure the linear polarization of ground scenes have been proposed for the Multispectral Resource Sampler (MRS), a satellite sensor system proposed to complement the Thematic Mapper. At present justification for a sensor on MRS to measure scene polarization is limited. This paper discusses a model for the amount of linearly polarized light reflected by the shiny leaves of such crops as wheat, corn, and sorghum. The theory demonstrates that, potentially, measurements of the linearly polarized light from a crop canopy may be used as an additional feature to discriminate between crops. Examination of the model suggests that, potentially, satellite polarization measurements may be used to monitor crop development stage, leaf water content, leaf area index, hail damage, and certain plant diseases. The model adds to the understanding of the potential information content of scene polarization measurements acquired by future satellite sensor systems such as MRS. (Author)

A81-46036 * Procedure M - A framework for stratified area estimation. R. J. Kauth, R. C. Cicone, and W. A. Malila (Michigan, Environmental Research Institute, Ann Arbor, MI). In: Machine processing of remotely sensed data and soil information systems and remote sensing and soil survey; Proceedings of the Sixth Annual Symposium, West Lafayette, IN, June 3-6, 1980.
New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 109-119. 20 refs. Contract No. NAS9-15476.

This paper describes Procedure M, a systematic approach to processing multispectral scanner data for classification and acreage estimation. A general discussion of the rationale and development of the procedure is given in the context of large-area agricultural applications. Specific examples are given in the form of test results on acreage estimation of spring small grains. (Author)

A81-46047 Use of Landsat digital data to assist in mapping soils on Arizona rangelands. E. H. Horvath, D. F. Post (Arizona, University, Tucson, AZ), W. M. Lucas (Santa Fe National Forest, Santa Fe, NM), and R. A. Weismiller (Purdue University, West Lafayette, IN). In: Machine processing of remotely sensed data and soil information systems and remote sensing and soil survey; Proceedings of the Sixth Annual Symposium, West Lafayette, IN, June 3-6, 1980. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 235-240. 17 refs. Research supported by the U.S. Bureau of Land Management and Coronado National Forest.

The outline and results of more than three years of field and laboratory studies are presented. Spectral maps generated from Landsat satellite data were used to aid in soil and vegetation surveys of five sites in southeastern Arizona. The sites are rangeland with varied physiography and relief, but generally sparse vegetation. It was found that spectral maps show a very positive correlation with grey tones or color patterns on photographs, and can be an excellent auxiliary tool for locating boundaries of mapping units. They can also aid in the location of representative sites for pedon descriptions, and could be used as an aid to quality control and map correlation studies in the field. The type and/or color of the geologic parent material was the dominant factor affecting the response recorded by the satellite. (Author)

A81-46050 A case study of soil erosion detection by digital analysis of the remotely sensed multispectral Landsat scanner data of a semi-arid land in southern India. V. Guruswamy, S. J. Kristof, and M. Baumgardner (Purdue University, West Lafayette, IN). In: Machine processing of remotely sensed data and soil information systems and remote sensing and soil survey; Proceedings of the Sixth Annual Symposium, West Lafayette, IN, June 3-6, 1980. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 266-272. 9 refs.

A81-46051 * Development of a digital data base for reflectance-related soil information. E. R. Stoner (NASA, Earth Resources Laboratory, Bay St. Louis, MS) and L. L. Biehl (Purdue University, West Lafayette, IN). In: Machine processing of remotely sensed data and soil information systems and remote sensing and soil survey; Proceedings of the Sixth Annual Symposium, West Lafayette, IN, June 3-6, 1980. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 273-279. 5 refs. Contract No. NAS9-15466.

A digital soils data base established for inclusion of soil reflectance data, physical, chemical, and engineering measurements, and site information is discussed. Initial data are taken from 500 soil samples covering the spectral range of 0.5 to 2.3 microns. Information obtained from each observation includes spectral data, and identification records with the soil and spectral observation parameters. The LARSPEC software system is available to retrieve and manipulate information, and scattergrams of identification and spectral data allow the initiation of statistical analyses of soil data. In addition, soil characteristics, graphical displays of reflectance spectra, and identification information examples are given. D.L.G.

A81-46054 * # Bulk processing techniques for very large areas - Landsat classification of California. W. Newland (Technicolor Graphic Services, Inc., Moffett Field, CA), D. Peterson, and S. Norman (NASA, Ames Research Center, Moffett Field, CA). In: Machine processing of remotely sensed data and soil information systems and remote sensing and soil survey; Proceedings of the Sixth Annual Symposium, West Lafayette, IN, June 3-6, 1980. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 306-318. 6 refs.

In 1977, California Law AB452 was passed to provide a mandate for the California Department of Forestry (CDF) to design and implement an information system to assess the forest land base for multiple uses and values. In connection with this mandate, a land-cover map of the entire state, emphasizing forest types, was produced. In producing this map, the latest techniques in digital image mosaicking were combined with the highspeed processing capability available on the ILLIAC IV parallel processor and other computer systems at the Ames Research Center (ARC). An operational and very responsive analysis method was developed at ARC that permitted on-time response to weekly workshops conducted with CDF field personnel to identify all 1,200 spectral classes and to produce final products. Over 100,000,000 acres were classified in the period between December 1, 1978, and April 15, 1979. All analyses were conducted using existing software. G.R.

A81-46055 * # Procedure 1 and forestland classification using Landsat data. R. F. Nelson (NASA, Goddard Space Flight Center, Greenbelt, MD) and R. M. Hoffer (Purdue University, West Lafayette, IN). In: Machine processing of remotely sensed data and soil information systems and remote sensing and soil survey; Proceedings of the Sixth Annual Symposium, West Lafayette, IN, June 3-6, 1980. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 319-325. 10 refs.

Procedure 1 (P-1) was developed for the Large Area Crop Inventory Experiment (LACIE) and has been used extensively to develop land-use classification of agricultural areas. The P-1 approach requires that pixels (also called dots) of known identity must be located in the study scene. The entire area is clustered and the spectral classes formed are identified using the dots. The analyst need only locate and identify the dots. The rest of the work is done by the computer. The objective of the reported study was to evaluate the effectiveness of P-1's automated approach in a complex forest-land situation. The study site was located in the eastern half of the San

Juan National Forest in southwestern Colorado. The study showed that P-1 performed as well as the Multicluster Blocks approach on the rugged study area. G.R.

A81-46056 Change vector analysis - An approach for detecting forest changes with Landsat. W. A. Malila (Michigan, Environmental Research Institute, Ann Arbor, MI). In: Machine processing of remotely sensed data and soil information systems and remote sensing and soil survey; Proceedings of the Sixth Annual Symposium, West Lafayette, IN, June 3-6, 1980.
New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 326-336. 9 refs. U.S. Department of Agriculture Contract No. 53-3197-8-19.

Periodic multiresource surveys and effective management of forest resources would be facilitated by capabilities for accurate detection of disturbances and other changes in land cover. Current techniques are not as effective and efficient as desired. This paper describes a recently developed digital method for change detection using multidate Landsat data. The method employs calculation of spectral change vectors from two different dates, prompting its name - Change Vector Analysis. The concept and a stratification procedure are described and their features are compared to other approaches. An implementation was tested that utilizes a linear transformation of Landsat data channels and spatial-spectral clustering of multidate data for the definition of spectrally homogeneous stand-like 'blobs'. Maps of two types of change, harvesting and regrowth, were produced and analyzed for a test site in Northern Idaho. (Author)

A81-46404 * Sampling Landsat classifications for crop area estimation. M. M. Hixson, B. J. Davis, and M. E. Bauer (Purdue University, West Lafayette, IN). *Photogrammetric Engineering and Remote Sensing,* vol. 47, Sept. 1981, p. 1343-1348. 8 refs. Contract No. NAS9-14970.

An investigation was conducted to evaluate the effect of several sampling alternatives on the accuracy of crop area estimates made from classification of Landsat Multispectral Scanner (MSS) data. The specific objective was to assess the precision and the bias associated with alternative sampling schemes involving different numbers of several sampling unit sizes. The estimates achieved using the 5 by 6 nm segments were found to have the least precision of any sampling scheme tested. The estimates become more precise as the segment size decreases and more segments are taken. The precision of the 5 by 6 nm segments was significantly less than that of the pixel samples. None of the sampling schemes was significantly biased on the average, and none of the average estimates differed significantly from the population parameter. The maximum absolute deviation, however, was directly related to sampling unit size and should be considered in selection of a sampling unit. G.R.

A81-46406 * Microdensitometry to identify saline rangelands on 70-mm color-infrared aerial film. J. H. Everitt, A. H. Gerbermann, and M. A. Alaniz (U.S. Department of Agriculture, Weslaco, TX). *Photogrammetric Engineering and Remote Sensing,* vol. 47, Sept. 1981, p. 1357-1362. 15 refs. NASA Order S-58376-G.

Many of the world's rangelands are affected by salinity. The detection of these areas is important to range and resource managers who are concerned with productivity, condition, and animal carrying capacity. The reported study was conducted along a north-to-south flight line 24 km long and 1.6 wide in Starr County, TX. Everitt et al. (1977) described seven different native range sites (four nonsaline and three saline) along this flight line. The study showed that photointerpretation by microdensitometry could be used to identify saline range sites quantitatively on CIR (0.50 to 0.90 micrometers) aerial film (scales 1:19,000, 1:42,000, and 1:80,000) exposed in May 1976, June 1976, and June 1979. Microdensitometer readings made on CIR film using white or blue light generally gave the best separation between saline and nonsaline range sites. The differences in microdensitometry readings among saline and nonsaline range sites were caused by less plant cover on the saline sites. G.R.

A81-46895 * Remote sensing of thermal radiation from an aircraft - An analysis and evaluation of crop-freeze protection methods. R. A. Sutherland, H. E. Hannah, A. F. Cook, and J. D. Martsolf (Florida, University, Gainesville, FL). *Journal of Applied Meteorology,* vol. 20, July 1981, p. 813-820. 17 refs. Research supported by the University of Florida; Contract No. NAS10-8920.

Thermal images from an aircraft-mounted scanner are used to evaluate the effectiveness of crop-freeze protection devices. Data from flights made while using fuel oil heaters, a wind machine and an undercanopy irrigation system are compared. Results show that the overall protection provided by irrigation (at approximately 2 C) is comparable to the less energy-efficient heater-wind machine combination. Protection provided by the wind machine alone (at approximately 1 C) was found to decrease linearly with distance from the machine by approximately 1 C/100 m. The flights were made over a 1.5 hectare citrus grove at an altitude of 450 m with an 8-14 micron detector. General meteorological conditions during the experiments, conducted during the nighttime, were cold (at approximately -6 C) and calm with clear skies. (Author)

A81-47354 The space engineering use efficiency for forest study. P. I. Moroz and V. S. Kudriavtsev (Vsesoiuznoe Ob'edinenie Lesproekt, Moscow, USSR). *International Astronautical Federation, International Astronautical Congress, 32nd, Rome, Italy, Sept. 6-12, 1981, Paper 81-108.* 7 p.

The principal factors determining the economic effect of space information use are given. They include an increase in labor productivity, a cut in expenditure and a shortening of periods of work by traditional means of replacement, an improvement in the nature-protective functions of forests, and a release of funds and their use in other industrial spheres. The use of space information for forestry purposes is seen as giving a considerable economic effect and as making it possible to solve tasks on a new qualitative level. The formula used in computing the economic effect is given. C.R.

A81-49344 Assessing winter wheat dry matter production via spectral reflectance measurements. J. K. Aase and F. H. Siddoway (U.S. Department of Agriculture, Northern Plains Soil and Water Research Center, Sidney, MT). *Remote Sensing of Environment,* vol. 11, Sept. 1981, p. 267-277. 27 refs.

A field experiment was located on a Williams loam soil, 11 km northwest of Sydney, MT. 'Roughrider', a winterhardy hard red winter wheat (Triticum aestivum L.) cultivar, was seeded to seven strands of from 0 to 100% (100% = 1,570,000 plants per hectare). On clear mornings, a hand-held radiometer was used to measure reflectances, corresponding to the Landsat multispectral scanner bands. Relationships between the normalized difference vegetation index as determined from late tillering until the beginning of flowering growth stages, and end-of-season straw and total dry matter clearly established the potential of remote sensing for predicting straw and total dry-matter yield. The prediction of dry-matter production is useful in providing an estimate of residue production for erosion control and as a potential source for feed and energy. B.J.

A81-49347 Thermal vegetation canopy model studies. J. A. Smith, K. J. Ranson, D. Nguyen, L. Balick (Colorado State University, Fort Collins, CO), L. E. Link (U.S. Army, Environmental Laboratory, Vicksburg, MS), L. Fritschen (Washington, University, Seattle, WA), and B. Hutchison (NOAA, Atmospheric Turbulence and Diffusion Laboratory, Oak Ridge, TN). *Remote Sensing of Environment,* vol. 11, Sept. 1981, p. 311-326. 29 refs. Grants No. DACW39-77-C-0073; No. DAAG29-79-C-0199.

An iterative-type thermal model applicable to forest canopies was tested with data from two diverse forest types. The model framework consists of a system of steady-state energy budget equations describing the interactions of short- and long-wave radiation within three horizontally infinite canopy layers. A state-space formulation of the energy dynamics within the canopy is used which permits a factorization of canopy geometrical parameters from canopy optical and thermal coefficients as well as environmental driving variables. Two sets of data characterizing a coniferous (Douglas-fir) and deciduous (oak-hickory) canopy were collected to evaluate the thermal model. The results show that the model approximates measured mean canopy temperatures to within 2 C for relatively clear weather conditions and deviates by a maximum of 3 C for very hazy or foggy conditions. (Author)

A81-49755 # Forestry priorities and their implications for the Canadian Remote Sensing Program. L. Sayn-Wittgenstein (DENDRON Resource Surveys, Ltd., Ottawa, Canada). In: Canadian

Symposium on Remote Sensing, 6th, Halifax, Canada, May 21-23, 1980, Proceedings. (A81-49751 24-43) Ottawa, Canadian Aeronautics and Space Institute, 1981, p. 33-35.

A81-49756 # **Operational applications for analysis of agricultural crops and cultural practices.** A. R. Mack (Department of Agriculture, Research Branch, Ottawa, Canada). In: Canadian Symposium on Remote Sensing, 6th, Halifax, Canada, May 21-23, 1980, Proceedings. Ottawa, Canadian Aeronautics and Space Institute, 1981, p. 37-42. 20 refs.

The evaluation of crop growth and field crop acreage from aerial imagery was begun by Agriculture Canada in the mid 1960's. By 1970, the studies were enlarged to include spectral data on crops and soils using a wide range of photographic and electronic measuring systems carried over the fields by both aircraft and satellites. During the last 15 years, these studies have repeatedly shown that certain groups of crops, types of crop losses, and crop growing conditions could be readily determined and their areal distribution in a crop district, region, or province accurately measured (e.g., corn, oil seeds, cereal crops, and fallowland). Growing conditions have been evaluated in recent years from Landsat imagery in dryland cereal growing areas for spring wheat and winter wheat. B.J.

A81-49760 # **Application of temporal Landsat forest digital data for updating the Yukon RRAMS data base using Aries.** Y. J. Lee (Pacific Forest Research Centre, Victoria, British Columbia, Canada). In: Canadian Symposium on Remote Sensing, 6th, Halifax, Canada, May 21-23, 1980, Proceedings. Ottawa, Canadian Aeronautics and Space Institute, 1981, p. 73-80. 9 refs.

The paper examines the effectiveness of temporal Landsat forest digital data as input to update the Yukon information retrieval system for renewable resources and management statistics (Yukon RRAMS). The temporal Landsat MSS data for a portion of the Lake Laberge Ecoregion were enhanced to emphasize softwood and hardwood stands. These enhanced images were used to locate training areas for supervised maximum likelihood classification. The results of the supervised classification were geometrically corrected and referenced to UTM grid cells. A summary of percentage occupancy in each 1/4-UTM grid cell by forest land classes was available for direct input to update the Yukon RRAMS data base. B.J.

A81-49764 * # **Technical aspects of forest inventory demonstrations using Landsat data - Projects in the Pacific Northwest States.** D. L. Peterson, G. Gnauk (NASA, Ames Research Center, Moffett Field, CA), and D. Noren (ESL, Inc., Sunnyvale, CA). In: Canadian Symposium on Remote Sensing, 6th, Halifax, Canada, May 21-23, 1980, Proceedings. Ottawa, Canadian Aeronautics and Space Institute, 1981, p. 105, 106.

A81-49766 # **Integration and comparison of SAR and MSS data for potato crop area estimation.** D. G. Goodenough, P. M. Teillet, and B. Guindon (Canada Centre for Remote Sensing, Ottawa, Canada). In: Canadian Symposium on Remote Sensing, 6th, Halifax, Canada, May 21-23, 1980, Proceedings. Ottawa, Canadian Aeronautics and Space Institute, 1981, p. 127-142. 9 refs. Research supported by the Department of Agriculture of Canada and New Brunswick Department of Agriculture and Rural Development.

Airborne SAR and Landsat MSS imagery was obtained in the summer of 1978 for an agricultural site located near Grand Falls, New Brunswick. In order to compare the performances of these two sensors, it was necessary to overlay the imagery on a common map (UTM) grid. Landsat imagery was corrected on the DICS system at CCRS. For the high-resolution airborne SAR data, a new rectification procedure was developed which models the aircraft flight parameters and uses terrain information in the form of a digital terrain model to remove image distortions introduced by topographic relief. In addition, using a feature selection technique, it was determined which combination of MSS and radar channels provided the greatest separability among the major target types in the Grand Falls area (i.e., potatoes, grains, pasture, fallow, and forest). B.J.

A81-49770 # **SAR image response over a conifer regeneration site.** E. Wedler, S. Pala, and A. Jano (Ministry of Natural Resources, Ontario Centre for Remote Sensing, Toronto, Canada). In: Canadian Symposium on Remote Sensing, 6th, Halifax, Canada, May 21-23, 1980, Proceedings. Ottawa, Canadian Aeronautics and Space Institute, 1981, p. 179-186. 5 refs.

A81-49782 # **Principal components enhancements versus classifications of Landsat images for forestry applications (Les accentuations numériques d'images Landsat contre les classifications automatisees pour la cartographie vegetale).** J. Beaubien (Ministère de l'Environnement, Centre de Recherches Forestières des Laurentides, Sainte-Foy, Quebec, Canada). In: Canadian Symposium on Remote Sensing, 6th, Halifax, Canada, May 21-23, 1980, Proceedings. Ottawa, Canadian Aeronautics and Space Institute, 1981, p. 301-305. In French.

Studies on the potential of Landsat data applied to forest vegetation inventory are becoming numerous; most are based on automated classifications, mainly supervised classification. As a result of two projects in Quebec, on the Laurentian Plateau and on the North Shore, the usefulness of two algorithms, i.e., classifications and principal component digital enhancements, is compared and discussed. Good color enhancement seems to give more information on forest vegetation cover than automated classifications. Color enhancement can be used in the field and interpreted as a color aerial photograph. The interpreter's knowledge and experience in forestry are used to produce a vegetation map based on field sampling. Classifications offer the advantages of automatically producing a map and of rapidly yielding the area occupied by each class; but depending on the complexity of the forest territory concerned and on the training sets, precision of results can be variable, especially when dealing with many classes. (Author)

A81-49784 # **Rapeseed - Guidelines for operational monitoring.** R. J. Brown, F. J. Ahern, R. A. Ryerson, K. P. B. Thomson, D. G. Goodenough, J. A. McCormick, and P. M. Teillet (Canada Centre for Remote Sensing, Ottawa, Canada). In: Canadian Symposium on Remote Sensing, 6th, Halifax, Canada, May 21-23, 1980, Proceedings. Ottawa, Canadian Aeronautics and Space Institute. 1981, p. 321-330. 8 refs.

Ground spectral measurements, airborne multispectral scanner (MSS) and Landsat MSS data were used to determine the phenological window during which rapeseed can be separated from its confusion crops on Landsat imagery. Ground spectroscopy measurements were used to predict the probability of correct classification of rapeseed and the results were confirmed using Landsat imagery acquired on three dates throughout the growing season. It was found that there are two phenological windows during which rapeseed can be reliably distinguished. One window corresponds to the period when the rapeseed is in bloom and the other when peas and the small grains are ripening. (Author)

A81-49785 # **Research on assessment of the recreational value of forests using Landsat digital data.** H. Amano. In: Canadian Symposium on Remote Sensing, 6th, Halifax, Canada, May 21-23, 1980, Proceedings. Ottawa, Canadian Aeronautics and Space Institute, 1981, p. 331-337. 6 refs.

The process of assessing the recreational values of forests and benefits thereof to the urban society by utilizing Landsat and complementary Japanese National Statistics is described. The study area selected (about 800,000 ha) was the Northern Kanto districts of Japan, located within 100 km north of Tokyo. Landsat data tapes were used to produce a digital map which consisted of seven land use classes. From this digital map, the forest distribution pattern and the degree of separability between forested and urban areas were expressed as Morisita's and Gini's index, respectively. The results show that the Landsat digital map is valuable for the estimation of quantitative recreation values of forest in relation to the urban area. In addition, Landsat data are in digital form, so that such maps can easily be processed. (Author)

A81-49786 # **Colour - The critical photointerpretation element in the identification of rangeland plant communities on colour and colour-infrared aerial photography.** E. K. Watson and A. L. van Ryswyk. In: Canadian Symposium on Remote Sensing, 6th, Halifax, Canada, May 21-23, 1980, Proceedings. Ottawa, Canadian Aeronautics and Space Institute, 1981, p. 339-349. 11 refs. Research supported by the Department of the Agriculture of Canada.

Although a review of the literature shows that color-infrared is

preferred over ordinary color film for range vegetation identification, the identification of variably colored grasses, forbs and shrubs becomes difficult due to the following properties of color-infrared film: (1) blue and green plants appear as similar magenta hues; (2) senescent yellow and white grasses both appear white; (3) purples, reds and red-browns appear as hues of yellow; and (4) the interaction of non-green flowers or stems with the color of the plant to yield a color shift. The elements of photointerpretation for the identification of some dominant range plant species are presented, with emphasis on the interactions of plant colors with multidate-multiscale color and color-infrared photography. Among the elements of photointerpretation treated are growth form distribution, habitat, pattern and texture. O.C.

A81-49787 # **Photointerpretation of fire damage to trees in a ponderosa pine/bunchgrass community.** P. A. Murtha, A. H. Johnson, and R. M. Strang (British Columbia, University, Vancouver, Canada). In: Canadian Symposium on Remote Sensing, 6th, Halifax, Canada, May 21-23, 1980, Proceedings. Ottawa, Canadian Aeronautics and Space Institute 1981, p. 351-359. 16 refs. Research supported by the Natural Sciences and Engineering Research Council, British Columbia Ministry of Agriculture, and Environment Canada.

This paper reports on the application of a new technique for photointerpretation of fire damage to trees in a ponderosa pine/bunchgrass community in British Columbia, reviews pertinent details of a 1978 fire-ecology study, and discusses aspects of photointerpretation of vegetation damage. Photointerpreted damage classes and optical densitometry to determine spectral-ratio deviations are suggested for photointerpretation of fire-related tree damage. The approach was tested on large-scale color-infrared aerial photographs of the fire-ecology plots. The results indicate that a combination of visual photointerpretation and calculated spectral ratio deviations provide a reliable photointerpretation technique for determination of fire impact on trees in the rangeland plant community. The remote sensing results are supported by independently-derived ground-based fire data. (Author)

A81-49789 # **The application of thermography for locating potential frost pockets in forest cutovers.** G. R. Lawrence (Ministry of Natural Resources, Ontario Centre for Remote Sensing, Toronto, Canada) and A. Banner (Intertech Remote Sensing, Ltd., Ottawa, Canada). In: Canadian Symposium on Remote Sensing, 6th, Halifax, Canada, May 21-23, 1980, Proceedings. Ottawa, Canadian Aeronautics and Space Institute, 1981, p. 369-376. 14 refs.

Cutover areas in three study sites were imaged in May with the aid of an airborne thermal scanner. Profiles of ground temperature, air temperature at 10 cm, and radiant temperature using a PRT-10 were prepared on two nights in November under similar weather conditions at a selected ground truth site. The data were compared with air temperature measurements done at the time of the overflight. The effects of nocturnal air drainage and pooling are successfully shown by the imagery. The study suggests that thermography holds promise for delineating relative frost hazards across forest cutovers. C.R.

A81-49791 # **The application of remote sensing techniques for an ecological land survey of the snow goose colony at Cape Henrietta Maria, Hudson Bay.** G. H. Wickware, D. W. Cowell (Environment Canada, Lands Directorate, Burlington, Ontario, Canada), R. A. Sims (Environment Canada, Canadian Forestry Service, Sault Ste. Marie, Ontario, Canada), and R. K. Ross (Canadian Wildlife Service, Ottawa, Canada). In: Canadian Symposium on Remote Sensing, 6th, Halifax, Canada, May 21-23, 1980, Proceedings. Ottawa, Canadian Aeronautics and Space Institute, 1981, p. 387-395. 10 refs.

A large expanding snow goose colony in the Cape Henrietta Maria area of Hudson Bay was studied with the aid of a multilevel remote sensing program. Training sites for each habitat were selected using 1:2000 scale 70 mm color and color infrared photography, while land systems were delineated using 1:60,000 scale black and white photography. Population estimates were made by means of a modified technique employed by Kerbes (1975), and a stratified random sample of all negatives within the colony's boundaries was selected to give overall areal coverage of 10%. Results of nesting density counts show a large increase in breeding pairs with only a small increase in the areal extent of the colony itself, and highest nest concentrations occur in the thicket meadow marsh and the graminoid brackish meadow marsh which are nearest to fluvially dominated areas and areas with a high density of brackish coastal lakes and ponds. D.L.G.

A81-49794 # **The discrimination of cereal crops and legumes using reflectance data in the Landsat bandpasses.** M. J. Duggin (New York, State University, Syracuse, NY) and G. C. Cooney (McQuarie University, Sydney, Australia). In: Canadian Symposium on Remote Sensing, 6th, Halifax, Canada, May 21-23, 1980, Proceedings. Ottawa, Canadian Aeronautics and Space Institute, 1981, p. 421-426. 5 refs. Research supported by the U.S. Department of Agriculture.

An example of the type of feasibility study which could usefully precede remote sensing surveys of, for example, different crop types or forest stands consisting of different tree types, is examined. The ground-level reflectance properties of several cereal crops and legumes are measured radiometrically for the Landsat satellite multispectral scanner (MSS) bandpasses on two occasions during the growth season. Multivariate analysis of the variance of the reflectance factor variables for the scanner bandpasses MSS 4 (500-600 nm), MSS 5 (600-700 nm), MSS 6 (700-800 nm), MSS 7 (800-1100 nm) and for log (base 10) MSS 7/5 shows that on each date the nine plant types are separable on the basis of reflectance properties. C.R.

A81-49799 # **Thermal inertia mapping of some areas of Quebec based on aerial and HCMM satellite data (Cartographie de l'inertie thermique de certains secteurs du Québec à partir de données aériennes et du satellite H.C.M.M.).** M. Bernier, R. Brochu, and F. Bonn (Sherbrooke, Université, Sherbrooke, Quebec, Canada). In: Canadian Symposium on Remote Sensing, 6th, Halifax, Canada, May 21-23, 1980, Proceedings. Ottawa, Canadian Aeronautics and Space Institute, 1981, p. 473-482. 17 refs. In French.

An example of the application of aerial and HCMM data to the construction of thermal inertia maps indicating soil moisture contents in regions of eastern Canada is presented. The aerial data was obtained in two flights at 1800 m over agricultural lands in the vicinity of Sherbrooke by means of thermography during day and night flights and multispectral photography during the day flight; preliminary treatment involved the division of the 5 x 1.25 km area into 400 pixels 125 m on a side and the acquisition of soil type, soil drainage, soil utilization and slope data for each pixel. Soil temperatures estimated from the thermographic data and albedos computed from an average of the reflectivities in the yellow-green, red and infrared spectral bands are used to derive the thermal inertia of each pixel. Examination of the thermal inertia distribution in comparison with soil drainage data indicates that the values of thermal inertia may be used to determine soil moisture in agricultural areas only if the complex relation between soil and vegetation temperature has been determined. In the case of HCMM data, obtained in the wavelength bands 0.5-1.1 and 10.5-12.0 microns with a pixel size of 481.5 m covering the entire southeast of Quebec, it is found that the resolution is too low to allow the use of the concept of thermal inertia in differentiating between regions of differing soil water content. A.L.W.

A81-49810 # ***A simulation of Thematic Mapper performance in an agricultural application.*** F. J. Ahern, R. J. Brown, D. G. Goodenough, and K. P.-B. Thomson (Canada Centre for Remote Sensing, Ottawa, Canada). In: Canadian Symposium on Remote Sensing, 6th, Halifax, Canada, May 21-23, 1980, Proceedings. Ottawa, Canadian Aeronautics and Space Institute, 1981, p. 585-596. 13 refs.

The Thematic Mapper (TM) to be flown on Landsat-D is expected to furnish significantly improved agricultural classification over the present Landsat multispectral scanner (MSS) because of its improved spectral bands and greater spatial, spectral, and radiometric resolution. It is noted that the expected performance of the TM in an agricultural application has been simulated from airborne MSS data as part of a CCRS project entitled The Saskatchewan Rangeland/Rapeseed Study. The performance of the TM is compared with the simulated and actual performance of the present Landsat multispectral scanner. It is pointed out that the TM bands can be

combined in a number of familiar and unfamiliar color composites. Some of these are created and displayed to demonstrate their value for agricultural applications. Using restricted versions of the simulated TM data set, the improvements in spectral classification with varying band combinations and varying radiometric and spatial resolution are determined. C.R.

A81-49815 # Evaluation of Thematic Mapper bands - A first step in feature selection. K. Staenz, F. J. Ahern, and R. J. Brown (Canada Centre for Remote Sensing, Ottawa, Canada). In: Canadian Symposium on Remote Sensing, 6th, Halifax, Canada, May 21-23, 1980, Proceedings. Ottawa, Canadian Aeronautics and Space Institute, 1981, p. 625-634. 16 refs.

It is pointed out that the Thematic Mapper (TM) on Landsat-D will produce more than 10 times the data than the present Landsat Multispectral Scanner (MSS) because of its increased dimensionality (7 bands) and improved ground resolution (30 m). However, the impact upon image analysis can be reduced by analyzing a subset of the data and thus reducing the dimensionality. A study is made to identify these possible subsets. The correlation between the reflectance factors of nine common crop types and one soil type in the first six TM spectral bands is determined. In similar fashion, the correlations between the Landsat MSS bands are calculated as a test of the available data set and procedure. C.R.

N81-28120# Joint Publications Research Service, Arlington, Va.

USE OF SATELLITE PICTURES FOR AGRICULTURE

D. Gergishvili *In its* USSR Rept.: Space, No. 9 (JPRS-77388) 2 Mar. 1981 p 26-27 refs Transl. into ENGLISH from Komunisti (USSR), 24 Jul. 1980 p 4

Avail: NTIS HC A03/MF A01

The functions of the hydrometeorological station in Telavi, Soviet Georgia, are described. Agroclimatic conditions affecting the grape crop are monitored to provide protection against natural hazards. Weather forecasts are produced, aerological, agrometeorological, hydrological, and meteorological data are collected, and environmental pollution monitored. The use of weather satellite data has improved their forecasting ability by 3.2 percent, and the accuracy of hail forecasting by 3.7 percent. J.D.H.

N81-28497*# Department of Agriculture, Houston, Tex.

LARGE AREA APPLICATION OF A CORN HAZARD MODEL

Pat Ashburn and T. W. Taylor, Principal Investigators Mar. 1981 15 p refs Sponsored by NASA, USDA, Dept. of Commerce, Dept. of the Interior, and Agency for International Development ERTS
(Proj. AgRISTARS)
(E81-10164; NASA-CR-160985; EW-UL-04074; JSC-17130) Avail: NTIS HC A02/MF A01 CSCL 02C

An application test of the crop calendar portion of a corn (maize) stress indicator model developed by the early warning, crop condition assessment component of AgRISTARS was performed over the corn for grain producing regions of the U.S.S.R. during the 1980 crop year using real data. Performance of the crop calendar submodel was favorable; efficiency gains in meteorological data analysis time were on a magnitude of 85 to 90 percent. Author

N81-28498*# Lockheed Engineering and Management Services Co., Inc., Houston, Tex.

A TEMPORAL/SPECTRAL ANALYSIS OF SMALL GRAIN CROPS AND CONFUSION CROPS

W. R. Johnson, Principal Investigators Mar. 1981 76 p refs Sponsored by NASA, USDA, Dept. of Commerce, Dept. of the Interior, and Agency for International Development ERTS
(Contract NAS9-15800; Proj. AgRISTARS)
(E81-10167; NASA-CR-160983; SR-L1-04054; LEMSCO-15676; JSC-17128) Avail: NTIS HC A05/MF A01 CSCL 02C

Spectral data from the LANDSAT-2 satellite were used to study the growth cycles of fields of wheat, barley, alfalfa, corn, sunflowers, soybeans, rye, flax, oats, millet, grass, and hay. Signatures of pastures, trees, and idle fallow were also studied. The growth cycles were portrayed in the form of temporal plots of the greeness-brightness transformation vector applied to average channel pixel values within the fields, all of which were in three counties in North Dakota. The plots of each crop reveal characteristics which can be used in crop classification procedures. A.R.H.

N81-28499*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

EFFECT OF FOREST CANOPY CLOSURE ON INCOMING SOLAR RADIANCE

C. Lisette Dottavio, Principal Investigator Apr. 1981 29 p refs Sponsored by NASA, USDA, Dept. of Commerce, Dept. of the Interior, and Agency for International Development ERTS (Proj. AgRISTARS)
(E81-10170; NASA-TM-82113; RR-G1-04085) Avail: NTIS HC A03/MF A01 CSCL 02F

In order to better understand the physical processes involved in defoliation assessment from remotely sensed data, a field study was designed to investigate the effect of forest canopy closure and other environmental variables on incoming solar radiation. Diffuse radiation measurements were recorded in red, infrared, and middle infrared wavelengths using the Mark 2 three band field radiometer. Results to date indicate that the percent canopy closure is the single most important variable affecting incoming solar radiation. In the visible and near infrared regions, interaction between time of day and date (defined later as solar zenith angle) also affect radiometric response. Aspect has only limited influence on radiance response. These same variables do not influence middle infrared response, however. Uniformity of the forest canopy appears to be more important. These results are compared to LANDSAT MSS classification results of gypsy moth defoliation. A.R.H.

N81-29494*# Lockheed Engineering and Management Services Co., Inc., Houston, Tex.

EVALUATION OF GRAVIMETRIC GROUND TRUTH SOIL MOISTURE DATA COLLECTED FOR THE AGRICULTURAL SOIL MOISTURE EXPERIMENT, 1978 COLBY, KANSAS, AIRCRAFT MISSION

L. M. Arya and D. E. Phinney, Principal Investigators Oct. 1980 307 p Sponsored by NASA, USDA, Dept. of Commerce, Dept. of the Interior, and Agency for International Development ERTS
(Contract NAS9-15800; Proj. AgRISTARS)
(E81-10114; NASA-CR-160966; SM-LO-00441; LEMSCO-14600; JSC-16357) Avail: NTIS HC A14/MF A01 CSCL 08M

Soil moisture data acquired to support the development of algorithms for estimating surface soil moisture from remotely sensed backscattering of microwaves from ground surfaces are presented. Aspects of field uniformity and variability of gravimetric soil moisture measurements are discussed. Moisture distribution patterns are illustrated by frequency distributions and contour plots. Standard deviations and coefficients of variation relative to degree of wetness and agronomic features of the fields are examined. Influence of sampling depth on observed moisture content an variability are indicated. For the various sets of measurements, soil moisture values that appear as outliers are flagged. The distribution and legal descriptions of the test fields are included along with examinations of soil types, agronomic features, and sampling plan. Bulk density data for experimental fields are appended, should analyses involving volumetric moisture content be of interest to the users of data in this report. A.R.H.

N81-29495*# Texas A&M Univ., College Station. Dept. of Mathematics.

DEVELOPMENT OF ADVANCED ACREAGE ESTIMATION METHODS Final Report, 1 Nov. 1979 - 31 Oct. 1980

L. F. Guseman, Jr., Principal Investigator Dec. 1980 133 p refs Sponsored by NASA, USDA, Dept. of Commerce, Dept. of the Interior, and Agency for International Development ERTS (Contract NAS9-14689; Proj. AgRISTARS)
(E81-10160; NASA-CR-161004; SR-TI-04112) Avail: NTIS HC A07/MF A01 CSCL 08B

The use of the AMOEBA clustering/classification algorithm was investigated as a basis for both a color display generation technique and maximum likelihood proportion estimation procedure. An approach to analyzing large data reduction systems was formulated and an exploratory empirical study of spatial correlation in LANDSAT data was also carried out. Topics addressed include: (1) development of multiimage color images; (2) spectral spatial classification algorithm development; (3) spatial correlation studies; and (4) evaluation of data systems. A.R.H.

N81-29499*# *Virginia Polytechnic Inst. and State Univ.*, Blacksburg.
NATIONWIDE FORESTRY APPLICATIONS PROGRAM. ANALYSIS OF FOREST CLASSIFICATION ACCURACY
Russell G. Congalton, Roy A. Mead, Richard G. Oderwald, and Joel Heinen, Principal Investigators 20 Jan. 1981 93 p refs Sponsored by NASA, USDA, Dept. of Commerce, Dept. of Interior, and Agency for International Development ERTS
(Proj. AgRISTARS)
(E81-10183; NASA-CR-160949; RR-U1-04066; JSC-17123) Avail: NTIS HC A05/MF A01 CSCL 02F

The development of LANDSAT classification accuracy assessment techniques, and of a computerized system for assessing wildlife habitat from land cover maps are considered. A literature review on accuracy assessment techniques and an explanation for the techniques development under both projects are included along with listings of the computer programs. The presentations and discussions at the National Working Conference on LANDSAT Classification Accuracy are summarized. Two symposium papers which were published on the results of this project are appended. A.R.H.

N81-29500*# Science and Education Administration, Phoenix, Ariz. Water Conservation Lab.
SOIL MOISTURE INFERENCES FROM THERMAL INFRARED MEASUREMENTS OF VEGETATION TEMPERATURES
R. D. Jackson, Principal Investigator Mar. 1981 14 p refs Sponsored by NASA, USDA, Dept. of Commerce, Dept. of Interior, and Agency for International Development ERTS
(Proj. AgRISTARS)
(E81-10184; NASA-CR-160954; EW-U1-04068; JSC-17125) Avail: NTIS HC A02/MF A01 CSCL 08M

Thermal infrared measurements of wheat (Triticum durum) canopy temperatures were used in a crop water stress index to infer root zone soil moisture. Results indicated that one time plant temperature measurement cannot produce precise estimates of root zone soil moisture due to complicating plant factors. Plant temperature measurements do yield useful qualitative information concerning soil moisture and plant condition. Author

N81-29504*# Environmental Research Inst. of Michigan, Ann Arbor.
USERS MANUAL FOR THE US BASELINE CORN AND SOYBEAN SEGMENT CLASSIFICATION PROCEDURE
Procedures Report, 15 Nov. 1979 - 14 Mar. 1981
Robert Horvath, Robert Colwell, Principal Investigators, C. Hay, M. Metzler, O. Mykolenko, J. Odenweller, and D. Rice Mar. 1981 274 p Sponsored by NASA, USDA, Dept. of Commerce, Dept. of the Interior, and Agency for International Development Prepared in cooperation with California Univ., Berkeley ERTS
(Contracts NAS9-15476; NAS9-14565; Proj. AgRISTARS)
(E81-10190; NASA-CR-160975; FC-E1-00712; ERIM-152400-1-X) Avail: NTIS HC A12/MF A01 CSCL 02C

A user's manual for the classification component of the FY-81 U.S. Corn and Soybean Pilot Experiment in the Foreign Commodity Production Forecasting Project of AgRISTARS is presented. This experiment is one of several major experiments in AgRISTARS designed to measure and advance the remote sensing technologies for cropland inventory. The classification procedure discussed is designed to produce segment proportion estimates for corn and soybeans in the U.S. Corn Belt (Iowa, Indiana, and Illinois) using LANDSAT data. The estimates are produced by an integrated Analyst/Machine procedure. The Analyst selects acquisitions, participates in stratification, and assigns crop labels to selected samples. In concert with the Analyst, the machine digitally preprocesses LANDSAT data to remove external effects, stratifies the data into field like units and into spectrally similar groups, statistically samples the data for Analyst labeling, and combines the labeled samples into a final estimate. J.M.S.

N81-29505*# National Oceanic and Atmospheric Administration, Houston, Tex. National Earth Satellite Service.
THE ENVIRONMENTAL VEGETATION INDEX: A TOOL POTENTIALLY USEFUL FOR ARID LAND MANAGEMENT
T. I. Gray, Jr. and D. G. McCrary, Principal Investigators Mar. 1981 6 p refs Repr. from Vol. of Extended Abstr.: 15th Conf. on Agr. and Forest Meteorol. and 5th Conf. on Biometeorol., 1981 p 205-207 Presented at the 15th Conf. on Agr. and Forest Meteorol. and 5th Conf. on Biometeorol., Anaheim, Calif., 1-3 Apr. 1981 Sponsored by NASA, USDA, Dept. of Commerce, Dept. of the Interior, and Agency for International Development ERTS
(Proj. AgRISTARS)
(E81-10191; NASA-CR-160978; EW-NI-04076; JSC-17132) Avail: NTIS HC A02/MF A01 CSCL 02C

The NOAA-6 AVHRR data sets acquired over South Texas and Mexico during the spring of 1980 and after Hurricane Allen passed inland are analyzed. These data were processed to produce the Gray-McCrary Index (GMI's) for each pixel location over the selected area, which area contained rangeland and cropland, both irrigated and nonirrigated. The variations in the GMI's appear to reflect well the availability of water for vegetation. The GMI area maps are shown to delineate and to aid in defining the duration of drought; suggesting the possibility that time changes over a selected area could be useful for irrigation management. Author

N81-29507*# Lockheed Engineering and Management Services Co., Inc., Houston, Tex.
DESCRIPTIVE AND SENSITIVITY ANALYSES OF WATBALI: A DYNAMIC SOIL WATER MODEL
W. W. Hildreth, Principal Investigator Mar. 1981 87 p refs Sponsored by NASA, USDA, Dept. of Commerce, Dept. of the Interior, and Agency for International Development ERTS
(Contract NAS9-15800; Proj. AgRISTARS)
(E81-10193; NASA-CR-160980; SM-LO-04021; LEMSCO-16572; JSC-16846) Avail: NTIS HC A05/MF A01 CSCL 08M

A soil water computer model that uses the IBM Continuous System Modeling Program III to solve the dynamic equations representing the soil, plant, and atmospheric physical or physiological processes considered is presented and discussed. Using values describing the soil-plant-atmosphere characteristics, the model predicts evaporation, transpiration, drainage, and soil water profile changes from an initial soil water profile and daily meteorological data. The model characteristics and simulations that were performed to determine the nature of the response to controlled variations in the input are described the results of the simulations are included and a change that makes the response of the model more closely represent the observed characteristics of evapotranspiration and profile changes for dry soil conditions is examined. A.R.H.

N81-29508*# Lockheed Engineering and Management Services Co., Inc., Houston, Tex.
EVALUATION OF SPRING WHEAT AND BARLEY CROP CALENDER MODELS FOR THE 1979 CROP YEAR
C. V. Nazare and J. G. Carnes, Principal Investigators Feb. 1981 35 p refs Sponsored by NASA, USDA, Dept. of Commerce, Dept. of the Interior, and Agency for International Development ERTS
(Contract NAS9-15800; Proj. AgRISTARS)
(E81-10197; NASA-CR-160977; FC-L1-04030; LEMSCO-15936; JSC-16850) Avail: NTIS HC A03/MF A01 CSCL 02C

During the Large Area Crop Inventory Experiment, spring wheat planting date and crop development stage estimates based on historical normals were improved by the use of the Feyerherm planting date and Robertson spring wheat crop calendar models. The Supporting Research Crop Calendar Project element modified the Robertson model to reduce bias at cardinal growth stages within the growing season. These models were tested in 1980 along with a state-of-the-art barley model (Williams) against a ground-truth data set from 49 calendar year 1979 segments in the U.S. Great Plains spring wheat and barley region. Author

N81-29511*# Lockheed Engineering and Management Services Co., Inc., Houston, Tex.
EVALUATION OF LARGE AREA CROP ESTIMATION TECHNIQUES USING LANDSAT AND GROUND-DERIVED DATA
M. L. Amis, R. K. Lennington, M. V. Martin, W. G. McGuire, and S. S. Shen, Principal Investigators Mar. 1981 136 p refs Sponsored by NASA, USDA, Dept. of Commerce, Dept. of the Interior, and Agency for International Development
(Proj. AgRISTARS)
(E81-10200; NASA-CR-160998; DC-LI-04051; LEMSCO-15763; JSC-17116) Avail: NTIS HC A06/MF A01 CSCL 02C

The results of the Domestic Crops and Land Cover Classification and Clustering study on large area crop estimation using LANDSAT and ground truth data are reported. The current crop area estimation approach of the Economics and Statistics Service of the U.S. Department of Agriculture was evaluated in terms of the factors that are likely to influence the bias and variance of the estimator. Also, alternative procedures involving replacements for the clustering algorithm, the classifier, or the regression model used in the original U.S. Department of Agriculture procedures were investigated. J.M.S.

N81-30507# Department of Agriculture, Washington, D.C. Statistical Research Div.

CROP AREA ESTIMATION USING GROUND-GATHERED AND SAMPLED LANDSAT DATA

James Weldon Mergerson May 1981 23 p refs
(PB81-192783; AGESS-810408) Avail: NTIS HC A02/MF A01 CSCL 02C

A comparative study in which a procedure using ground gathered data and classified LANDSAT data for estimating crop area were compared to procedures using ground gathered data and sampled LANDSAT data is described. Data from parts of Iowa and Missouri were used. Unitemporal data were used in Iowa and multitemporal data were used in Missouri. Results indicate that some sampling schemes can be used without any significant difference in the crop area estimates, but with a large reduction in cost for corn, soybeans, and winter wheat. GRA

N81-30508# Georgia Inst. of Tech., Atlanta. Applied Sciences Lab.

AGRICULTURAL WATER DEMAND PREDICTION USING REMOTE SENSING TECHNOLOGY FOR GEORGIA RESOURCE MANAGEMENT

John R. Jensen and Donald L. Chery Dec. 1980 57 p refs Sponsored by Dept. of Interior Prepared in cooperation with Georgia Univ., Athens
(PB81-184137; W81-02428; ERC-07-80; OWRT-A-083-GA(1))
Avail: NTIS HC A04/MF A01 CSCL 02C

A method to assess the amount of water pumped from aquifers or the effect of intensive agriculture on watershed water balance (WWB) is discussed. Certain measurements are needed to model WWB. The major flow components are (1) rainfall input, and (2) out flows of evapotranspiration (ET) and surface and subsurface discharge. ET is determined by careful selection and analysis of LANDSAT digital data to determine an agriculture region's land cover; ET was used in a hydrologic water balance model. Digital image processing of LANDSAT-3 data discriminated major field crops and forests in Tift County, Georgia, for a water use assessment. GRA

N81-30511# Department of Agriculture, Washington, D.C. Statistical Reseach Div.

AGRISTARS (AGRICULTURE AND RESOURCES INVENTORY SURVEYS THROUGH AEROSPACE REMOTE SENSING) DC/LC (DOMESTIC CROPS AND LAND ROVER) PROJECT SUMMARY CROP AREA ESTIMATES FOR KANSAS AND IOWA, 1980

David D. Kleweno and Charles E. Miller Mar. 1981 20 p refs
(PB81-196909; AGESS-810414) Avail: NTIS HC A02/MF A01 CSCL 02B

The major crop area estimation element of the 1980 AgRISTARS DC/LC project as implemented by the Economics and Statistics Service is described. Data from NASA Earth resources monitoring satellites, LANDSAT II and III, were used in conjunction with conventionally gathered ground data to provide 1980 crop area estimates of harvested winter wheat in Kansas and planted soybeans and corn in Iowa. GRA

N81-31595 Arizona Univ., Tucson.

SPECTRAL PROPERTIES OF ARIZONA SOILS AND RANGELANDS AND THEIR RELATIONSHIP TO LANDSAT DIGITAL DATA Ph.D. Thesis

Emilio Hubert Horvath 1981 196 p
Avail: Univ. Microfilms Order No. 8116702

The relationships between the spectral properties of Arizona soils and rangelands and their characteristics were studied. The per cent reflectance of soils was determined using a multispectral hand-held radiometer, and the spectral response of Arizona rangeland sites was measured by scanners aboard on orbiting satellite. These spectral properties were related, by means of stepwise multiple regressions, to various soil and site characteristics. It was shown that for central and southern Arizona rangelands, it is possible to define specific relationships between site characteristics and satellite measured spectral response. Less than ten site characteristics and their interactions explain considerable portions of the variability between mapping units for a given survey. These relationships are unique for specific locations, but they could easily be developed for a survey area and effectively used in the mapping process. Dissert. Abstr.

N81-31596*# National Oceanic and Atmospheric Administration, Houston, Tex.

METEOROLOGICAL SATELLITE DATA: A TOOL TO DESCRIBE THE HEALTH OF THE WORLD'S AGRICULTURE

T. I. Gray, Jr., D. G. McCrary, Principal Investigators, and L. Scott Feb. 1981 12 p refs Sponsored by NASA, USDA, Dept. of Commerce, Dept. of the Interior, and Agency for International Development Prepared in cooperation with Lockheed Engineering and Management Services Co., Inc., Houston, Tex. ERTS
(Contract NAS9-15800; Proj. AgRISTARS)
(E81-10204; NASA-CR-160953; EW-NI-04042;
LEMSCO-15978; JSC-17112) Avail: NTIS HC A02/MF A01 CSCL 02C

Local area coverage data acquired aboard the TIROS-N satellite family by the advanced very high resolution radiometer systems was examined to determine the agricultural information current. Albedo differences between channel 2 and channel 1 of the advanced very high resolution radiometer LAC (called EVI) are shown to be closely correlated to the Ashburn vegetative index produced from LANDSAT multispectral scanner data which have been shown to vary in response to 'greenness', soil moisture, and crop production. The statistical correlation between the EVI and the Ashburn Vegetative Index (+ or - 1 deg) is 0.86.
Author

N81-31597*# Lockheed Engineering and Management Services Co., Inc., Houston, Tex.

A DESCRIPTION OF THE REFORMATTED SPRING SMALL GRAINS LABELING PROCEDURE USED IN TEST 2, PART 2 OF THE US/CANADA WHEAT AND BARLEY EXPLORATORY EXPERIMENT

W. F. Palmer and E. R. Magness, Principal Investigator Feb. 1981 42 p refs Sponsored by NASA, USDA, Dept. of Commerce, Dept. of the Interior and Agency for International Development ERTS
(Contract NAS9-15800; Proj. AgRISTARS)
(E81-10206; NASA-CR-160969; FC-LO-04000;
LEMSCO-15404; JSC-16827) Avail: NTIS HC A03/MF A01 CSCL 02C

The reformatted spring small grains labeling procedure is designed to be used for assigning crop identification labels to a predetermined and selected number of dots. The development and description of this procedure is presented. Author

N81-31598*# Lockheed Engineering and Management Services Co., Inc., Houston, Tex.

CLASSIFICATION OF WHEAT: BADHWAR PROFILE SIMILARITY TECHNIQUE

Willa W. Austin Oct. 1980 32 p refs Sponsored by NASA, USDA, Dept. of Commerce, Dept. of the Interior, and Agency for International Development ERTS
(Contract NAS9-15800; Proj. AgRISTARS)
(E81-10207; NASA-CR-160970; SR-LO-00499;
LEMSCO-15305; JSC-16826) Avail: NTIS HC A03/MF A01 CSCL 02C

The Badwar profile similarity classification technique used successfully for classification of corn was applied to spring wheat classifications. The software programs and the procedures used to generate full-scene classifications are presented, and numerical results of the acreage estimations are given. J.M.S.

N81-31599*# Lockheed Engineering and Management Services Co., Inc., Houston, Tex.

WEATHER ANALYSIS AND INTERPRETATION PROCEDURES DEVELOPED FOR THE US/CANADA WHEAT AND BARLEY EXPLORATORY EXPERIMENT

M. H. Trenchard, Principal Investigator Nov. 1980 49 p refs Sponsored by NASA, USDA, Dept. of Commerce, Dept. of the

Interior, and Agency for International Development ERTS
(Contract NAS9-15800; Proj. AGRISTARS)
(E81-10208; NASA-CR-160971; FC-LO-04014;
LEMSCO-15612; JSC-16840) Avail: NTIS HC A03/MF A01
CSCL 02C

Procedures and techniques for providing analyses of meteorological conditions at segments during the growing season were developed for the U.S./Canada Wheat and Barley Exploratory Experiment. The main product and analysis tool is the segment-level climagraph which depicts temporally meteorological variables for the current year compared with climatological normals. The variable values for the segment are estimates derived through objective analysis of values obtained at first-order station in the region. The procedures and products documented represent a baseline for future Foreign Commodity Production Forecasting experiments. Author

N81-31614# Department of Agriculture, Washington, D.C. Economics and Statistics Service.
CROP AREA ESTIMATES USING GROUND-GATHERED AND LANDSAT DATA. A MULTITEMPORAL APPROACH: MISSOURI, 1979
James Weldon Mergerson Feb. 1981 30 p refs
(PB81-186751; AGESS-810223) Avail: NTIS
HC A03/MF A01 CSCL 02D

Four channel data were used for the unitemporal approach. Eight channel data consisting of four channels from each of two dates were used for the multitemporal approach. The multitemporal data set and the two corresponding unitemporal data sets were analyzed using various procedures. Results indicated that the use of multitemporal data can significantly improve the precision of crop area estimates for corn, soybeans, and winter wheat, obtained using the unitemporal approach. GRA

N81-32576*# Lockheed Engineering and Management Services Co., Inc., Houston, Tex.
ANALYSIS OF US SPRING WHEAT AND SPRING BARLEY PERIODIC GROUND TRUTH Interim Report
T. Hodges, Principal Investigator Jan. 1981 51 p refs Sponsored by NASA, USDA,, Dept. of Commerce, Dept. of the Interior and Agency for International Development ERTS
(Contract NAS9-15800; Proj. AgRISTARS)
(E81-10203; NASA-CR-161005; SR-LO-04012;
LEMSCO-15698; JSC-16837) Avail: NTIS HC A04/MF A01
CSCL 02C

An attempt to document the size and geographic distribution of phenological differences between spring wheat and spring barley in the U.S. Great Plains is described. Severe inconsistencies found in the two sets of data taken at 51 segments in Montana, North Dakota, and South Dakota are discussed. A.R.H.

N81-32577*# Department of Agriculture, Houston, Tex.
YIELD MODEL DEVELOPMENT (YMD) IMPLEMENTATION PLAN FOR FISCAL YEARS 1981 AND 1982
Russell A. Ambroziak, Principal Investigator Mar. 1981 138 p Sponsored by NASA, USDA, Dept. of Commerce, Dept. of the Interior and Agency for International Development ERTS
(Proj. AgRISTARS)
(E81-10211; NASA-CR-160951; YM-J1-C0618; JSC-16857)
Avail: NTIS HC A07/MF A01 CSCL 02C

A plan is described for supporting USDA crop production forecasting and estimation by (1) testing, evaluating, and selecting crop yield models for application testing; (2) identifying areas of feasible research for improvement of models; and (3) conducting research to modify existing models and to develop new crop yield assessment methods. Tasks to be performed for each of these efforts are described as well as for project management and support. The responsibilities of USDA, USDC, USDI, and NASA are delineated as well as problem areas to be addressed. A.R.H.

N81-32578*# Lockheed Engineering and Management Services Co., Inc., Houston, Tex. Remote Sensing Technology Implementation Project.
PHOTOGRAPHIC TECHNOLOGY DEVELOPMENT PROJECT: TIMBER TYPING IN THE TAHOE BASIN USING HIGH ALTITUDE PANORAMIC PHOTOGRAPHY Final Report
J. F. Ward Jun. 1981 42 p refs Sponsored in part by Dept. of Agriculture Original Contains Color Illustrations
(Grant NGR-53-3182-0-29)
(NASA-CR-161082; LEMSCO-15691) Avail: NTIS
HC A03/MF A01 CSCL 14E

Procedures were developed and tested for using KA-80A optical bar camera panoramic photography for timber typing forest land and classifying nonforest land. The study area was the south half of the Lake Tahoe Basin Management Unit. Final products from this study include four timber type map overlays on 1:24,000 orthophoto maps. The following conclusions can be drawn from this study: (1) established conventional timber typing procedures can be used on panoramic photography if the necessary equipment is available, (2) The classification and consistency results warrant further study in using panoramic photography for timber typing; and (3) timber type mapping can be done as fast or faster with panoramic photography than with resource photography while maintaining comparable accuracy. A.R.H.

N81-32588# Army Engineer Topographic Labs., Fort Belvoir, Va
LANDFORM-VEGETATION RELATIONSHIPS IN THE NORTHERN CHIHUAHUAN DESERT
Melvin B. Satterwhite and Judy Ehlen 29 Mar. 1981 21 p refs
(AD-A102896; ETL-R020) Avail: NTIS HC A02/MF A01 CSCL 08/6

The description and monitoring of environmental resources in arid regions can be a formidable undertaking requiring substantial resources. These efforts can be expedited by using remote sensing techniques. There remains, however, a need for correlating features that are readily extracted from the imagery with anticipated soil and vegetation conditions on the ground. Landform features provide a basis for the assessment of soil and vegetation conditions and these features can be readily identified from aerial photography and, to a certain extent, from LANDSAT imagery. The purpose of this study was to evaluate landform features as a basis for the assessment of soil and vegetation conditions. The study was conducted on 650,000 hectares in the northern Chihuahuan Desert (south-central New Mexico and western Texas). Landform conditions and plant communities were identified from an analysis of stereo panchromatic aerial photography, and were evaluated in detail by intensive field investigations. Soil conditions of the various landforms identified from the imagery were established by the laboratory analysis of field samples. The distribution of the plant communities was closely correlated to landform conditions and the edaphic factors affecting plant-available soil-water, soil texture, soil depth, infiltration, and slope. GRA

N81-33339# European Space Agency, Paris (France).
COHERENT AND INCOHERENT RADAR SCATTERING FROM ROUGH SURFACES AND VEGETATED AREAS
T. D. Guyenne, comp. and G. Levy, comp. May 1981 166 p refs Proceedings of ESA-EARSeL Workshop, Alpbach, Austria, 16-20 Mar. 1981 Sponsored in cooperation with Austrian Solar and Space Agency and DFVLR
(ESA-SP-166; ISSN-0379-6566) Avail: NTIS
HC A08/MF A01

The comparison of scatterometer results and radar images with respect to the physical information content is presented. Scatterometer systems, imaging radar systems, synthetic aperture radar (SAR), volume and surface scatter theories and their applications are studied. Scatterometer measurements on crop and soil surfaces, scatterometer calibration, and optimal polarization concept in radar imaging are discussed.

N81-33349# Centre National de la Recherche Scientifique, Toulouse (France). Centre d'Etude Spatiale des Rayonnements.
SCATTEROMETER MEASUREMENTS ON CROP AND SOIL SURFACES
Thuy LeToan *In* ESA Coherent and Incoherent Radar Scattering from Rough Surfaces and Vegetated Areas May 1981 p 99-110 refs
Avail: NTIS HC A08/MF A01

Scatterometer experiments on soil moisture detection and crop monitoring are summarized. Radar backscatter is found to be correlated to and sensitive to the soil moisture of the upper layer 0 to 5 cm at frequencies of 4 to 5 GHz and at an angle of incidence of 0 to 20 deg. The influence of soil texture on

dielectric properties of moist soils led to defining a moisture parameter that accounts for this dependence. Research on crop identification and monitoring pointed out the large fluctuations of backscattering coefficient with time during the growing season, thus the need of multidate data for crop identification potentialities of radar for crop parameter detection and growth stage determination. Author (ESA)

N81-33542*# Texas A&M Univ., College Station. Remote Sensing Center.

DRYLAND PASTURE AND CROP CONDITIONS AS SEEN BY HCMM Progress Report, Jan. - Apr. 1980

J. C. Harlan, Principal Investigator, W. D. Rosenthal, and Bruce J. Blanchard Apr. 1980 19 p Original contains imagery. Original imagery may be purchased from NASA Goddard Space Flight Center, (code 601), Greenbelt, Md. 20771. Domestic users send orders to 'Attn: National Space Science Data Center'; non-domestic users send orders to 'Attn: World Data Center A for Rockets and Satellites'. HCMM

(Contract NAS5-24383)

(E81-10080; NASA-CR-164749; PR-3712-9) Avail: NTIS HC A02/MF A01 CSCL 02C

Daily antecedant precipitation indexes (API) values were calculated from precipitation amounts at each rain gage on the Washita River watershed; daytime thermal IR data from the watershed on July 24 was compared to July 13 daytime IR data covering the same area. Surface moisture conditions on the 13th were drier. A good relationship is apparent between thermal temperature difference around each rain gage site and the corresponding API value on July 24, 1978. Thirty-six hour day/night registered IR data at each rain gage on October 16/17 was compared to the corresponding daily API. Thermal patterns associated with an October 8 storm were still detectable but not as strongly as day/day differences between July 24 and 13. Analysis began on the IR data from the 10 HCMM CCT's tapes, received as well as on GOES visible and IR data for July 21 and 28, 1978. The spatial and thermal resolution in the latter were too gross to detect minor soil moisture differences which were detectable during the same period on HCMM thermal data. A.R.H.

N81-33543*# Dartmouth Coll., Hanover, N.H.

AN INVESTIGATION OF VEGETATION AND OTHER EARTH RESOURCE/FEATURE PARAMETERS USING LANDSAT AND OTHER REMOTE SENSING DATA. 1: LANDSAT. 2: REMOTE SENSING OF VOLCANIC EMISSIONS Semiannual Status Report, 1 Feb. - 31 Jul. 1981

Richard W. Birnie and Richard E. Stoiber, Principal Investigators 31 Jul. 1981 44 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S.D. 57198. ERTS

(Contract NCC5-22)

(E81-10081; NASA-CR-164750; SASR-3) Avail: NTIS HC A03/MF A01 CSCL 08F

The application of a classification algorithm for mixture landscapes to LANDSAT data in order to inventory one-half million acres of forest land in northern Maine is reported as well as efforts to develop a user-oriented mapping system for forestry applications. Ash samples and ash leachates from volcanoes around the world were cataloged and analyzed. An instrument developed for remotely sensing HCl gas is being calibrated and evaluated. A real-time computer line for the COSPEC is under investigation in order to facilitate analysis of SO2 emission at a more detailed level than possible before. Evidence of increased magmatic gas component from Mt. St. Helens is documented and volcanic activity in Nicaragua is summarized. A.R.H.

N81-33545*# Texas A&M Univ., College Station. Remote Sensing Center.

MEASUREMENT OF SOIL MOISTURE TRENDS WITH AIRBORNE SCATTEROMETERS Progress Report, 1 Jan. 1980 - Jan. 1981

M. J. McFarland, Cheryl Jones, Sidney W. Theis, and Wesley D. Rosenthal, Principal Investigators 1 Jan. 1981 49 p ERTS

(Grant NsG-5134)

(E81-10078; NASA-CR-164752; RSC-3458-5) Avail: NTIS HC A03/MF A01 CSCL 08M

Soil moisture data collected in conjunction with aircraft data approximately 4 miles northwest of Dalhart, Texas are summarized. Ground data were collected in 22 fields extending along two parallel 11-mile lines running east-west. The sample fields included corn, pasture, millet and fallow fields selected for their suitability for analysis with aircraft data. A NASA C130 flew every other day along the two flight lines. Two passes were flown on each line with various sensors operating on each pass. The sensor included a PRT-5, NS001 thematic mapper, MMS, L and C band passive microwave radiometers and 13.3, 4.75, 1.6 and .4 GHz scatterometers. In addition, low and medium altitude color infrared photography and special calibration data were gathered. The ground work, the fields, procedures in the field and lab, and the final data sets are described. A.R.H.

N81-33546*# Lockheed Engineering and Management Services Co., Inc., Houston, Tex.

INTERIM CATALOG GROUND DATA SUMMARY, DATA ACQUISITION YEAR 1978

V. L. Cook and H. M. Doyle, Principal Investigators Mar. 1981 37 p Sponsored by NASA, USDA, Dept. of Commerce, Dept. of the Interior, and Agency for International Development ERTS

(Contract NAS9-15800; Proj. AgRISTARS)

(E81-10132; NASA-CR-161035; MU-L1-04056; LEMSCO-16325; JSC-17120) Avail: NTIS HC A03/MF A01 CSCL 02C

Those sample segment number for which aircraft data were acquired and/or field inventory data were produced in 1978 are listed by states. Detail specifications, background information, description of the format, sources of information, and an explanation of procedures for the catalog are included. A.R.H.

N81-33549*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

A COMPARATIVE STUDY OF THE THEMATIC MAPPER AND LANDSAT SPECTRAL BANDS FROM FIELD MEASUREMENT DATA

G. D. Badhwar and K. E. Henderson, Principal Investigators Mar. 1981 21 p refs Sponsored by NASA, USDA, Dept. of Commerce, Dept. of the Interior, and Agency for International Development ERTS

(Proj. AgRISTARS)

(E81-10165; NASA-TM-84032; SR-JO-04029; JSC-16849) Avail: NTIS HC A02/MF A01 CSCL 02C

Principal component and factor analysis techniques were applied to the spectral data collected over 27 field plots of various crops under varying agronomic conditions. The spectral data was integrated over the proposed thematic mapper bands and LANDSAT MSS spectral bands. The results were examined to compare the discrimination power of the thematic mapper. Author

N81-33554*# Minnesota Univ., St. Paul. Dept. of Soil Science.

A PROJECT TO EVALUATE MOISTURE STRESS AND PHENOLOGICAL FACTORS IN CORN AND SOYBEAN AREAS OF SOUTHWESTERN AND SOUTH-CENTRAL MINNESOTA

R. H. Rust and Pierre Robert, Principal Investigators *In its* A Study of Minn. Land and Water Resources Using Remote Sensing, Vol. 14 1 Jan. 1981 18 p refs Original contains color imagery. Original photography may be purchased from the EROS Data Center, Souix Falls, S.D. 57198. ERTS

Avail: NTIS HC A05/MF A01 CSCL 02C

The capability of aerial color infrared photography for identifying and locating soilscapes most susceptible to drought development or those having different soil drainages was evaluated. Although west central and southwestern Minnesota had a significant precipitation deficit during the 1980 crop season, indications of plant stress were not observed either from ground observation or through interpretation of imagery at the selected sampling sites. Well-drained soil was more depleted during the 'maximium green peak' period than the poorly drained soil. The recharge was more evident on the poorly drained site in the fall. Measurements of leaf water potential and leaf temperature for corn and soybean leaves were made by multispectral band scanner and recorded for analysis. A.R.H.

N81-33555*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

AgRISTARS: FOREIGN COMMODITY PRODUCTION

FORECASTING. PROGRAM REVIEW PRESENTATION TO LEVEL 1, INTERAGENCY COORDINATION COMMITTEE Semiannual Project Management Report
Roy Eason, Principal Investigator 6 Nov. 1980 123 p Sponsored by NASA, USDA, Dept. of Commerce, Dept. of the Interior, and Agency for International Development Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S.D. 57198. ERTS
(Proj. AgRISTARS)
(E81-10168; NASA-TM-84030; FC-J0-04010; JSC-16835) Avail: NTIS HC A06/MF A01 CSCL 02C

Accomplishments made since March 1980 in developing and testing procedures to provide more objective and reliable crop production forecasts several times during the growing season as well as improved preharvest estimates for a range of countries and crops are summarized. Results of classification procedures verification and simulated aggregation tests are included as well as evaluations of crop stage model performance. The status of wheat/barley and corn/soybean experiments is examined and the extension of the methods used in the experiments to multicrop sampling and aggregation is considered. The foreign similarity region approach, objectives and scopes for FY-81, and major changes in the FY81/82 plan are examined. A.R.H.

N81-33558*# Kansas Univ., Lawrence. Space Technology Center.
CROP PHENOLOGY AND LANDSAT-BASED IRRIGATED LANDS INVENTORY IN THE HIGH PLAINS: APPENDICES Final Report
[1981] 201 p refs ERTS
(Grant NAG2-57)
(E81-10172; NASA-CR-164565) Avail: NTIS HC A10/MF A01 CSCL 02C

Data collected in an effort to produce a master crop calendar in map and tabular format for the High Plains Aquifer are presented. Contents include: a key to the counties in the High Plains Aquifer; USDA Economics and Statistic Service data for 1979; Agricultural Stabilization and Conservation Service data for 1979 and 1980; Cooperative Extension Service data for 1979 and 1980; recording methods from questionnaire; scatterplots portraying ASCS, Extension and ESS data; crop irrigation maps; and weekly summary based optimal LANDSAT dates. A bibliography is included. A.R.H.

N81-33559*# Kansas Univ., Lawrence. Space Technology Center.
CROP PHENOLOGY AND LANDSAT-BASED IRRIGATED LANDS INVENTORY IN THE HIGH PLAINS Final Report
E. A. Martinko, Principal Investigator, J. Poracsky, E. R. Kipp, H. Krieger, and K. Gunn [1981] 139 p ERTS
(Grant NAG2-57)
(E81-10173; NASA-CR-164566) Avail: NTIS HC A07/MF A01 CSCL 02C

The need to determine the volume of ground water being pumped from the High Plains region aquifer (HPRA) for irrigation can be met using a LANDSAT based remote sensing system. Crop calendar differences in such a large area (most of Nebraska, half of Kansas, the Texas and Oklahoma Panhandle areas, a portion of South Dakota, and the eastern parts of Wyoming, Colorado, and New Mexico) can introduce local influences on the interpretation of the algorithms employed. A method is described for determining the optimal dates for inventorying various crops grown on these irrigated lands in support of an effort to identify irrigated and develop a computer model for predicting aquifer response to changes in ground water development. A crop calendar for the crops grown in the HPRA is presented. A.R.H.

N81-33561*# Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.
EVALUATION OF LANDSAT DATA ANALYSIS FOR FOREST SURVEY Final Report
R. P. Mroczynski, R. M. Hoffer, and R. F. Nelson, Principal Investigators 1980 47 p refs Sponsored by NASA and US Forest Service Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S.D. 57198. ERTS
(E81-10175; NASA-CR-164754; LARS-TR-101880) Avail: NTIS HC A03/MF A01 CSCL 02F

LANDSAT classification results are compared to current survey statistics for forest/non-forest classes in the northeastern aspen-birch survey unit in Minnesota. The results help to provide: the first step in a land change monitoring system; estimates of cost of local and regional land use statistics obtained from LANDSAT; and information regarding the degree of information that can be extracted from LANDSAT. The possibility of detecting disturbance on survey plots was determined. The possible application of forest survey ground plots as training material for computer-aided LANDSAT classification is discussed. T.M.

N81-33564*# Tulsa Univ., Okla. Div. of Mathematical Sciences.
MAXIMUM LIKELIHOOD ESTIMATION FOR MIXTURE MODELS
R. A. Redner, Principal Investigator Oct. 1980 51 p refs Sponsored by NAsA, USDA, Dept. of Commerce, Dept. of the Interior and Agency for International Development Prepared in cooperation with Lockhead Engineering and Management Services Co., Inc., Houston, Tex. ERTS
(Contract NAS9-15800; Proj. AgRISTARS)
(E81-10178; NASA-CR-160967; SR-J0-04007; LEMSCO-14880; JSC-16832) Avail: NTIS HC A04/MF A01 CSCL 12A

The maximum likelihood estimation of parameters in mixture model is discussed, the use of ancillary information in the maximum likelihood process is shown, and the strong consistency of the maximum likelihood estimator is proven. A study of these three areas leads to a threshold maximum estimator which estimates the number of classes in a mixture model. This estimator, along with the iteration procedure by which it is calculated, is described. Local and global results for the procedure are given. A.R.H.

N81-33565*# Lockheed Engineering and Management Services Co., Inc., Houston, Tex.
AUSTRALIAN TRANSITION YEAR SPECIAL STUDIES
R. W. Payne and T. E. Armstrong, Principal Investigators Jan. 1981 110 p Sponsored by NASA, USDA, Dept. of Commerce, Dept. of the Interior and Agency for International Development Original contains color imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S.D. 57198. ERTS
(Contract NAS9-15800; Proj. AgRISTARS)
(E81-10179; NASA-CR-160968; FC-L0-00464; LEMSCO-14808; JSC-16368) Avail: NTIS HC A06/MF A01 CSCL 02C

The processing of Australian data during LACIE transition year resulted in identification of the major issues in classification, sampling/aggregation, yield, and production. Classification issues which were identified and/or partially resolved are those concerned with early-season and late-season wheat varieties, abandonment, confusion crops, and ancillary data problems, especially crop calendar problems. Labeling accuracy results and ground-truth data from a New South Wales sample segment are included with results, conclusions, and recommendations for crop labeling and labeling-related issues. A.R.H.

N81-33573*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
A CROP MOISTURE STRESS INDEX FOR LARGE AREAS AND ITS APPLICATION IN THE PREDICTION OF SPRING WHEAT PHENOLOGY
P. C. Doraiswamy and D. R. Thompson, Principal Investigtors Mar. 1981 28 p refs Sponsored by NASA, USDA, Dept. of Commerce, Dept. of the Interior and Agency for International Development Prepared in cooperation with Lockheed Engineering and Management Services Co., Inc., Houston, Tex. ERTS
(Contract NAS9-15800; Proj. AgRISTARS)
(E81-10202; NASA-TM-84035; SR-L1-04064; JSC-17121; LEMSCO-16216) Avail: NTIS HC A03/MF A01 CSCL 02C

An agrometeorological crop phenology model for spring wheat is presented which incorporates the photothermal concept suggested by the Robertson crop calendar model for spring grains. This model differs from the Robertson model in that it incorporates a crop moisture stress index as a model parameter. The data used to assess the effects of moisture stress on phenological development were derived from the literature. In certain parts of the model, it is suggested that remotely sensed spectral data may be used as inputs. The model is applicable to large area forecasting and incorporates the influence of soil moisture deficit

on phenological development. Model outputs representing a moisture-stressed condition and an adequate moisture condition are discussed for growth observations in North Dakota and Montana. A.R.H.

N81-33575*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

EXPERIMENT PLAN: ROW AND ROUGHNESS EFFECTS ON DEPENDENCE OF ACTIVE MICROWAVE MEASUREMENTS OF SOIL MOISTURE

J. F. Paris and L. M. Arya, Principal Investigators Oct. 1980 38 p refs Sponsored by NASA, USDA, Dept. of Commerce, Dept. of the Interior, and Agency for International Development Prepared in cooperation with Lockheed Engineering and Management Services Co., Inc., Houston, Tex. ERTS (Proj. AgRISTARS)

(E81-10209; NASA-TM-84048; SM-J0-00613; JSC-16822; LEMSCO-15181) Avail: NTIS HC A03/MF A01 CSCL 08M

To increase understanding of the effects of agricultural tillage practices and aspect angle on the interpretation of active microwave data over bare agricultural fields, an experiment is planned for determining the effects of different combinations of row spacings and heights at L-band, C-band, and Ku-band for viewing angles of 10 deg, 20 deg, 30 deg, 40 deg, and 50 deg and for HH polarization. The objectives give scope, approach, test site description, and data requirements for the experiment. The data is to be gathered at the Prairie View A&M University, Texas test site and at Jornada, New Mexico. A data analysis plan is proposed including error analysis for estimating the modulation function. A.R.H.

N81-33588# Battelle Inst., Frankfurt am Main (West Germany). Abt. Laser und Optik.

EXPERIMENTAL INVESTIGATION OF THE PHYSICAL FUNDAMENTALS FOR REMOTE SENSING OF SOIL AND VEGETATION MOISTURE BY ACTIVE INFRARED REFLECTANCE SPECTROSCOPY USING CO2 LASER TECHNIQUE

Final Report

Joerg Boscher and Frank Lehman (Zentralstelle fuer Geo-Photogrammetrie und Fernerkundung) Bonn Bundesministerium fuer Forschung und Technologie Dec. 1980 39 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie

(BMFT-FB-W-80-037; BF-R-64-028-01; ISSN-0170-1339) Avail: NTIS HC A03/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 8,20

The application of active infrared spectroscopy to remote sensing of soil moisture was examined. The reflectance of water and dry and moist soil samples, including selected minerals and natural soils, was measured with the emission lines of the CO2 laser. The reflectance spectra of the samples change in a characteristic way with increasing moisture. Spectral differences of the dry materials are reduced with increasing water content, enabling the use of the ratio of the reflected intensities of two CO2 laser lines to determine the moisture content of surfaces. The airborne remote sensing system (DIALEX) developed for differential absorption spectroscopy of gases can be employed for two channel reflectance spectroscopy. Applications of this moisture sensing method in the fields of mineral deposits prospecting, agriculture and forestry are discussed. Author (ESA)

N81-33598# Technicolor Graphic Services, Inc., Sioux Falls, S. Dak.

A SELECTED BIBLIOGRAPHY: REMOTE SENSING APPLICATIONS IN WILDLIFE MANAGEMENT

David M. Carneggie, Donald O. Ohlen, and Lawrence R. Pettinger 23 Feb. 1981 24 p

(Contract DI-14-08-0001-16439)

(PB81-215881) Avail: NTIS HC A02/MF A01 CSCL 13B

This bibliography cites 165 selected technical reports, journal articles, and other publications on remote sensing applications for wildlife management. Developments in the use of remotely sensed data for wildlife habitat mapping, habitat inventory, habitat evaluation, and wildlife census are covered. The works cited were published between 1947 and 1979. GRA

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02

ENVIRONMENTAL CHANGES AND CULTURAL RESOURCES

Includes land use analysis, urban and metropolitan studies, environmental impact, air and water pollution, geographic information systems, and geographic analysis.

A81-41061 # **Hurricane 'Flossie' /September 1978/ observed in the north Atlantic, by the Meteosat satellite (L'uragano 'Flossie' /Settembre 1978/ visto dal Meteosal sul nord Atlantico).** S. Zanni (Centro Nazionale di Meteorologia e Climatologia Aeronautica, Rome, Italy). *Rivista di Meteorologia Aeronautica,* vol. 41, Jan.-Mar. 1981, p. 33-42. 14 refs. In Italian.

The behavior of hurricane Flossie (September 1978) in the north Atlantic in terms of the monthly mean September circulation is interpreted. Some brief remarks and meteosynoptic suggestions regarding Flossie's genesis and development are presented, also in analogy with other similar hurricanes in this segment of the Atlantic ocean mainly in fall, season of highest tropical storm activity. Finally some interpretations of two Meteosat infra-red and water vapour images which show the maximum stage of Flossie moving sharply northward to the Atlantic extra-tropical latitudes are presented. (Author)

A81-41404 **Stratospheric sulfate from the Gareloi eruption, 1980 - Contribution to the 'ambient' aerosol by a poorly documented volcanic eruption.** W. A. Sedlacek, E. J. Mroz, and G. Heiken (California, University, Los Alamos, NM). *Geophysical Research Letters,* vol. 8, July 1981, p. 761-764. 5 refs.

While sampling stratospheric aerosols during July-August 1980 a plume of 'fresh' volcanic debris was observed in the Northern Hemisphere. The origin of this material seems to be a poorly documented explosive eruption of Gareloi volcano in the Aleutian Islands. The debris was sampled at an altitude of 19.2 km - almost twice the height of observed eruption clouds. Such remote, unobserved or poorly documented eruptions may be a source that helps maintain the 'ambient' stratospheric aerosol background. (Author)

A81-42281 # **Remote sensing and mapping of pastures (Distantsionnaia indikatsiia i kartirovanie pastbishch).** B. V. Vinogradov. *Issledovanie Zemli iz Kosmosa,* May-June 1981, p. 35-45. 24 refs. In Russian.

Aerial and space surveys were used to study the composition, structure, phenology, and dynamics of pastures. The topography method of pastural survey is discussed at several levels, ranging from the detailed (population) and elementary (biogenetic) to the local and regional. The most up-to-date method involves the determination of pastural changes caused by overgrazing. This is done by comparing repeated aerial and space photographs of the same territory and recording the pastural modifications of land use by means of overgrazing and desertification indicators during a single flight. J.F.

A81-43261 * **Application of remote sensing for California irrigated lands assessment.** L. Tinney, J. Estes (California, University, Santa Barbara, CA), S. Wall, and R. Colwell (California, University, Berkeley, CA). In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979. Minneapolis, MN, American Water Resources Association, 1981, p. 689-693. Grant No. NsG-2208.

Recognizing the need for land use data as an input to State water planning, the California Department of Water Resources (DWR) and its predecessor agencies have conducted land use surveys since the late 1940's. In 1957 the California Water Plan was established. A statewide assessment is compiled every four to five years to review overall water resource conditions. Satellite remote sensing imagery, such as available from Landsat, has been recognized by DWR as a potential source of land use data. Analysis of Landsat imagery in connection with 'calibrating' data from low altitude photography and/or field checks can provide an economical means for providing a large scale, single year base inventory of general land use. The purpose of the Applications Pilot Test is to develop and document the use of Landsat for such an inventory. Towards the overall goal of developing an operational methodology that DWR could cost effectively implement four tasks have been specified. G.R.

A81-43263 **Remote sensing of bank erosion along the Missouri River, South Dakota.** P. H. Rahn (South Dakota School of Mines and Technology, Rapid City, SD). In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979. Minneapolis, MN, American Water Resources Association, 1981, p. 697-700.

In South Dakota, rapid erosion and deposition occurs below the main stem dams on the Missouri River. A description is presented of the use of Landsat imagery to quantify the amount of erosion in a reach below Gavins Point Dam. Landsat imagery of the entire reach below Gavins Point Dam was obtained and compared and images were chosen based on available cloud-free days, for the days of May 30, 1973 and February 23, 1976. It is pointed out that satellite imagery adds a new dimension to fluvial studies by allowing for repetitive (temporal) coverage of a stream reach. The considered study shows that it is possible to periodically assess areas of erosion and deposition for the Missouri River. G.R.

A81-43523 # **Remote methods and desert conservation (Distantsionnye metody i okhrana prirody pustyn').** N. G. Kharin. Moscow, Izdatel'stvo Nauka, 1980. 104 p. 124 refs. In Russian.

The application of remote sensing methods in the study of desert resources for the prevention of destructive processes and the planning of desert reclamation are examined. Problems in the monitoring of natural resources to which remote methods may successfully be applied are considered, including the study of vegetation damage, land use, soil erosion and salinization, water resources and pollution and natural disasters, and space-borne, aerial and ground-based methods used in resource monitoring are presented. The application of multispectral aerospace photography for the thematic mapping of desert areas is then examined, with attention given to the determination of optimum spectral regions, the characteristics of the photographs obtained, map correction, and the feasibility of using the maps in the planning of conservation measures. Attention is also given to the application of remote methods in the mapping of conservation zones in desert regions and the study of natural preserves in arid regions. A.L.W.

A81-43533 **Comparison of sampling procedures and data analysis for a land-use and land-cover map.** K. Fitzpatrick-Lins (U.S. Geological Survey, Reston, VA). *Photogrammetric Engineering and Remote Sensing,* vol. 47, Mar. 1981, p. 343-351. 9 refs.

The accuracy of the Tampa, Florida Land-Use and Land-Cover Map produced by the U.S. Geological Survey at a scale of 1:250,000 was estimated by the use of two separate sample selections, a manual sample selection, and a computer automated sample selection. A comparison of these two methods favors the second. The manual sample selection used a stratified systematic unaligned sampling technique. The computer-based automated sample selection first used a stratified systematic unaligned sampling technique followed by a random selection stratified by category to assure that all categories were adequately sampled. With the manual sample selection only six of the 26 categories were adequately represented, and nine were not represented at all. Using the computer-based sample selection, all 26 categories were represented. B.J.

A81-43534 **Spatial correlation effects upon accuracy of supervised classification of land cover.** J. B. Campbell (Virginia Polytechnic Institute and State University, Blacksburg, VA). *Photogrammetric Engineering and Remote Sensing,* vol. 47, Mar. 1981, p. 355-363. 19 refs.

The Landsat 1 multispectral scanner imaged south central Virginia at six dates during the 1974 growing season. The examination of selected parcels of forest reveals the presence of positive continuity between MSS values at adjacent pixels; the degree of continuity varies from date to date, and according to MSS bands at a

given date. In at least some cases, it can be shown that estimates of category variances based on values at contiguous pixels yield low values relative to those based on random samples of the same area. These biased estimates can lead to overestimation of contrast between categories and to errors in supervised classification. Erroneously classified pixels may tend to cluster, thus increasing the opportunity for misinterpretation of errors as genuine land-cover parcels. B.J.

A81-43733 * Urban area update procedures using Landsat data. D. L. Toll (NASA, Goddard Space Flight Center, Greenbelt, MD), J. A. Royal (General Electric Co., Space Systems Div., Beltsville, MD), and J. B. Davis (U.S. Bureau of Census, Geography Div., Washington, DC). In: Rainbow 80; Fall Technical Meeting, Niagara Falls, NY, October 7-10, 1980, ASP Technical Papers. Falls Church, VA, American Society of Photogrammetry, 1981, p. RS-1-E-1 to RS-1-E-17. 18 refs.

Landsat digital enhancements and classification maps are shown to be useful for updating the urban expansion of standard metropolitan statistical areas on a macro scale. Automated procedures for detecting nonurban to urban land coverage change using multitemporal Landsat data are investigated for five metropolitan areas, showing an overall delineation similar to that obtained from large scale aerial photography. The evaluated change detection procedures include image differencing, principal component transformation prior to differencing, and post classification comparison. Results show that image differencing techniques in MSS band 5 provide the most accurate land cover change detections. J.F.

A81-43739 From landforms to avian habitat - A look at topology. J. E. Skaley (Cornell University, Ithaca, NY). In: Rainbow 80; Fall Technical Meeting, Niagara Falls, NY, October 7-10, 1980, ASP Technical Papers. Falls Church, VA, American Society of Photogrammetry, 1981, p. RS-2-E-1 to RS-2-E-8. 8 refs.

A landscape approach, in which basic topological relationships among shapes and patterns in the terrain are identified, has been used to predict local climate and potential songbird habitat. Geometric models and topological relationships among basic patterns are shown to provide a focus for quantifying and understanding relationships between terrain features. Three case studies are presented, exemplifying nature's tendency to repeat basic shapes and patterns which can be used to predict landscape properties. Illustrations are provided, showing topological shapes related to landform features, forest canopy characteristics, air flow patterns, and heating and cooling patterns. Associations between avian groups and different topological features and canopy structures are given. It is suggested that these relationships be examined in greater detail as a way of quantifying the interpretation process and improving landscape analysis. J.F.

A81-43748 Use of remote sensing in landscape stratification for environmental impact assessment. J. A. Stanturf (Cornell University, Ithaca, NY) and D. G. Heimbuch (Heimbuch-Stanturf, Inc., Ithaca, NY). In: Rainbow 80; Fall Technical Meeting, Niagara Falls, NY, October 7-10, 1980, ASP Technical Papers. Falls Church, VA, American Society of Photogrammetry, 1981, p. PS-2-A-1 to PS-2-A-11. 22 refs.

Landscape units, used in environmental impact assessment, are delineated by integrating remotely sensed data and available single-factor data. A remote sensing approach to landscape stratification is described, and shown to be superior to other approach that require single-factor maps under certain conditions. Flow charts show the steps necessary for developing classification criteria, delineating units and a map legend, and using the landscape units in impact assessment. The approach is then applied to assess impacts of a transmission line to illustrate the method. J.F.

A81-43749 * Texture measurements from Seasat - SAR images for urban land use interpretation. F. Fasler (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA). In: Rainbow 80; Fall Technical Meeting, Niagara Falls, NY, October 7-10, 1980, ASP Technical Papers. Falls Church, VA, American Society of Photogrammetry, 1981, p. PS-2-B-1 to PS-2-B-10. 9 refs. Contract No. NAS7-100.

Different grey tones in Seasat Synthetic Aperture Radar (SAR) images for the same type of urban land cover considerably impair the possibilities of establishing automatic classification procedures for these types of data. Since the orientation of the main features like street patterns and buildings with respect to the azimuth angle of the radar antenna is the crucial factor for the observed differences in grey tone, prior information on these elements and special processing of the data would be required to eliminate this effect. Another approach suggested in this paper is to make use of the textural information in the image rather than of its grey tone. For different study sites within the Los Angeles urbanized area texture measures could be derived which result in characteristic values for specific types of land cover and are largely independent of the azimuth angle effect. At the same time the results for the study area indicate an improvement of the overall separability for the different land cover types included in the analysis. (Author)

A81-44515 * # Measurements of CF2Cl2, CFCl3, and N2O in the lower stratosphere between 2 deg S and 73 deg N latitude. J. F. Vedder, E. C. Y. Inn, B. J. Tyson, C. A. Boitnott (NASA, Ames Research Center, Atmospheric Experiments Branch, Moffett Field, CA), and D. O'Hara (EAL Corp., Richmond, CA). *Journal of Geophysical Research,* vol. 86, Aug. 20, 1981, p. 7363-7368. 20 refs.

Mixing ratios are presented for CF2Cl2, CFCl3, and N2O in the lower stratosphere. They are derived from measurements made on samples collected by a high-altitude aircraft during a survey in the northern hemisphere in the summer of 1977. The vertical distributions of the mixing ratios of these species show a decrease with increasing altitude and a marked decrease at a given altitude with increasing latitude from 2 deg S to 73 deg N latitude. These results agree with measurements at similar latitudes in the fall of 1976 and with results of other experiments. The experimental apparatus and procedures are described in greater detail than in previous papers. (Author)

A81-44526 # Aerosol formation, transformation, and effects in Denver's emissions plume. C. C. Van Valin, R. F. Pueschel, and D. L. Wellman (NOAA, Environmental Research Laboratories, Boulder, CO). *(International Association of Meteorology and Atmospheric Physics, International Conference on Budget and Cycles of Trace Gases and Aerosols, 4th, Boulder, CO, Aug. 12-18, 1979.) Journal of Geophysical Research,* vol. 86, Aug. 20, 1981, p. 7463-7470. 22 refs.

During November and December 1978, a field study was conducted with the primary objective to identify the factors and substances that cause the reduction of visibility and the gray-brown color of the polluted air mass, the 'brown cloud', during winter pollution episodes. Gases and aerosols over the Denver metropolitan area and at varying distances downwind were measured with a research aircraft. Near the principal emissions source area, the particle number distribution was found to be dominated by nucleus mode aerosols, the O3 concentration was much lower than background, and the NO concentration was greater than that of NO2. After a few hours reaction during sunlight, the O3 concentrations were greater than background, most of the NO had been converted to NO2, and the accumulation mode particles were comparatively more numerous than in the young pollution cloud. A mechanism has been identified for the removal of NO2 from the atmosphere during periods of high relative humidity. G.R.

A81-44684 Texture analysis and urban land use classification. C. A. Harlow, R. W. Conners, M. M. Trivedi, D. A. DiRosa, and R. E. Vasquez-Espinosa (Louisiana State University, Baton Rouge, LA). In: SOUTHEASTCON '81; Proceedings of the Region 3 Conference and Exhibit, Huntsville, AL, April 5-8, 1981. Piscataway, NJ, Institute of Electrical and Electronics Engineers, Inc., 1981, p. 115-119. 10 refs.

Image processing techniques have been applied to the analysis of urban scenes. Many characteristics of land use patterns are given by the spatial variations of the gray shades in the image. Texture analysis is an image processing technique developed to analyze spatial variations in gray shades. A texture analysis technique based upon the Spatial Gray Level Dependence Method (SGLDM) has been developed. This method utilizes statistical and structural analysis and is therefore called a statistical and structural texture analysis procedure (SSA). The SSA texture analysis procedure has been

applied to the analysis and classification of a digitized photograph of a complex urban scene. (Author)

A81-44701 A comparison of automatic classification algorithms for land use map by remotely sensed data. S. Fujimura and H. Toyota (Tokyo, University, Tokyo, Japan). In: SOUTHEASTCON '81; Proceedings of the Region 3 Conference and Exhibit, Huntsville, AL, April 5-8, 1981. Piscataway, NJ, Institute of Electrical and Electronics Engineers, Inc., 1981, p. 299-303.

The results of various supervised classification algorithms for the preparation of land use maps based on remotely sensed multispectral data are compared in order to illustrate some of the problems in the selection of the most suitable algorithm. Multispectral data obtained in the Fukuyama district of Japan was classified by the maximum likelihood method, the linear discriminant function method, the minimum Euclidean distance method and the correlation method with and without normalization of the mean, and the correct classification rates of the various methods were analyzed. The relative accuracies of the methods are found not to be in the order predicted under the assumption of a normal data distribution. Further analysis reveals this to be due to the lack of generality of the training data. It is thus recommended that when the statistical properties of the training data vary greatly from one category to another, the minimum Euclidean distance method or the linear discriminant function method be used rather than the more common maximum likelihood method. A.L.W.

A81-44862 ISS-b experimental results on global distributions of ionospheric parameters and thunderstorm activity. N. Matuura (Ministry of Posts and Telecommunications, Radio Research Laboratories, Nakaminato, Ibaraki, Japan), M. Kotaki, S. Miyazaki, E. Sagawa, and I. Iwamoto (Ministry of Posts and Telecommunications, Radio Research Laboratories, Koganei, Tokyo, Japan). *(International Astronautical Federation, International Astronautical Congress, 31st, Tokyo, Japan, Sept. 22-27, 1980.) Acta Astronautica,* vol. 8, May-June 1981, p. 527-548. 19 refs.

Experimental results from the Ionosphere Sounding Satellite-b (ISS-b) are presented, with emphasis on the global distribution of such ionospheric parameters as (1) critical frequency (foF2); (2) the probability of occurrence of spread echoes; (3) nighttime electron temperature and ionic constituents of the ambient plasma; and (4) thunderstorms detected by means of radio technique. Detailed maps are presented for all four missions of the satellite, for a period lasting from August 1978 to June 1979. O.C.

A81-45406 # Investigation of the efficiency of the optical sounding of aerosol by the use of spectral photometers (Issledovanie effektivnosti opticheskogo zondirovaniia aerozolia s ispol'zovaniem spektral'nykh fotometrov). B. S. Kostin. In: Investigation of atmospheric aerosol by means of laser sounding.
Novosibirsk, Izdatel'stvo Nauka, 1980, p. 70-83. 12 refs. In Russian.

A method is developed for the analysis of the efficiency of the optical sounding of atmospheric aerosol by spectral photometers; the method is based on the comparison of results obtained from the inversion of optical measurements with data from direct measurements of the microstructure of atmospheric aerosol. This approach makes it possible to compare the absolute values of particle concentrations. It is shown that, within the limits of measurement error, the inversion results agree well with direct-measurement data. F.G.M.

A81-45434 Land use mapping of Hong Kong from Landsat images - An evaluation. C. P. Lo (University of Hong Kong, Hong Kong). *International Journal of Remote Sensing,* vol. 2, July-Sept. 1981, p. 231-252. 15 refs.

Landsat 70 mm film images are evaluated for planimetric accuracy and the accuracy of land use interpretation for the production of land use maps of Hong Kong. Maps are produced for a 1061 sq km area at a scale of 1:250,000 using a Fairey additive viewer, and at a scale of 1:88,500 using manual interpretation, demonstrating that information can be improved with further enlargement of the Landsat segment despite resolution limitations. An urban land use map at a scale of 1:25,000 is also generated with a computer assisted method of Landsat data analysis, demonstrating lower accuracy due to the intensity of urban land use. Although the maps do not reach the accuracy of aerial photography, they are of an acceptable planimetric and semantic accuracy, and are relatively cheap while allowing frequent revisions. D.L.G.

A81-45437 Procedures for change detection using Landsat digital data. P. J. Howarth (McMaster University, Hamilton, Ontario, Canada) and G. M. Wickware (Environment Canada, Canada Centre for Inland Waters, Burlington, Ontario, Canada). *International Journal of Remote Sensing,* vol. 2, July-Sept. 1981, p. 277-291. 17 refs. Research supported by the Natural Sciences and Engineering Research Council of Canada, Prairie Regional Office of Parks.

Procedures in applying complementary methods of band ratioing and post-classification change detection to monitor a large remote area are presented. Work by Wickware and Howarth (1980) demonstrating the use of band ratioing and post-classification detection is also presented, including methods for detecting, displaying and measuring environment change. Band ratioing, classification, change matrices, binary theme prints and conflict character assignment maps are found to provide a practical sequence for analyzing hydrologic and vegetation changes. In addition, the amount of information required is found to depend on the complexity of the problem and the level and type of resource management decision to be made. D.L.G.

A81-45862 A differential inversion method for high resolution atmospheric remote sensing. M. M. Abbas (Drexel University, Philadelphia, PA). In: Remote sensing of atmospheres and oceans; Proceedings of the Interactive Workshop on Interpretation of Remotely Sensed Data, Williamsburg, VA, May 23-25, 1979. New York, Academic Press, Inc., 1980, p. 1-14; Discussion, p. 15-18. 7 refs.

The spectral lines of atmospheric gases may be fully resolved with high resolution observations by techniques, such as infrared heterodyne spectrometers. An inversion method suitable for such observations is discussed and is found to have several advantages over conventional methods. The method is based on matching the derivatives of the observed radiances or transmittances with the calculated values for the modeled atmosphere. The proposed method provides a significant narrowing of the weighting functions and improvement in the overall accuracy of the retrieved profiles. The method is applied to inversion of ozone absorption lines in the earth's atmosphere and the results are compared with those obtained with a conventional method. (Author)

A81-45870 * Role of multiple scattering in ozone profile retrieval from satellite measurements in the ultraviolet. S. L. Taylor, P. K. Bhartia, V. G. Kaveeshwar, K. F. Klenk (Systems and Applied Sciences Corp., Riverdale, MD), A. J. Fleig (NASA, Goddard Space Flight Center, Greenbelt, MD), and C. L. Mateer (Department of the Environment, Atmospheric Environment Service, Downsview, Ontario, Canada). In: Remote sensing of atmospheres and oceans; Proceedings of the Interactive Workshop on Interpretation of Remotely Sensed Data, Williamsburg, VA, May 23-25, 1979. New York, Academic Press, Inc., 1980, p. 219-229; Discussion, p. 230, 231. 6 refs.

The retrieval of the ozone profile from satellite ultraviolet measurements can be extended to greater depths when multiple scattering is taken into account. The sensitivity of the multiple-scattered wavelength radiances to geophysical variables are discussed and results of profile inversions of Nimbus 4 backscatter ultraviolet data for coincident ground-truth measurements with and without multiple scattering are presented. (Author)

A81-46044 The use of CIR and airborne multispectral scanner techniques for wetland soils mapping of highway corridors. A. E. Redfield (Dames and Moore, Washington, DC) and K. S. Thom (General Electric Co., Space Div., Lanham, MD). In: Machine processing of remotely sensed data and soil information systems and remote sensing and soil survey; Proceedings of the Sixth Annual Symposium, West Lafayette, IN, June 3-6, 1980.
New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 205-213. 9 refs. Research sponsored by the U.S. Department of Transportation.

This paper summarizes the results of an investigation aimed at evaluating the potential advantages of state-of-the-art airborne remote sensing for highway siting and planning tasks, specifically in

wetland areas. The basic objectives of the study were to develop methodologies using remotely sensed data for mapping wetlands soils and drainage, to evaluate the relative merits and usefulness of the various methods developed, to generate a selection of output products from the remote sensor data for display to highway planners and photointerpreters, and to provide recommendations for implementation of remote sensing techniques in the highway planning and siting process. To accomplish these objectives, remote sensor and ground truth data were acquired for selected test sites in Florida, Michigan, and Minnesota. One of several test sites in Michigan has been selected as representative of the study objectives and methodology. (Author)

A81-46046 The methodology of CIAT's land resource study of tropical America. T. T. Cochrane (International Centre for Tropical Agriculture, Cali, Columbia). In: Machine processing of remotely sensed data and soil information systems and remote sensing and soil survey; Proceedings of the Sixth Annual Symposium, West Lafayette, IN, June 3-6, 1980. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 227-234. 23 refs.

A description is given of an agricultural land resource evaluation program aimed at the effective development and transfer of germplasma-oriented technology to Central and South America. The study reduces land information to a common base in terms of land systems that are defined as repetitive patterns of climate, soils and landscape, delineated directly onto satellite and side-looking radar imagery. The system facilitates the analysis of the land resource data with other information, including economic parameters, and is playing an increasingly important role as a dynamic land resource data bank for the region's crop, pasture and agro-forestry production. O.C.

A81-46407 * Analysis of landfills with historic airphotos. T. L. Erb, W. R. Philipson, W. L. Teng, and T. Liang (Cornell University, Ithaca, NY). *Photogrammetric Engineering and Remote Sensing*, vol. 47, Sept. 1981, p. 1363-1369. Research supported by the New York State Dept. of Health; Grant No. NGL-33-010-071.

An investigation is conducted regarding the value of existing aerial photographs for waste management, including landfill monitoring. The value of historic aerial photographs for documenting landfill boundaries is shown in a graph in which the expansion of an active landfill is traced over a 40-year period. Historic aerial photographs can also be analyzed to obtain general or detailed land-use and land-cover information. In addition, the photographs provide information regarding other elements of the physical environment, including geology, soils, and surface and subsurface drainage. The value of historic photos is discussed, taking into account applications for inventory, assessing contamination/health hazards, planning corrective measures, planning waste collection and facilities, developing inactive landfills, and research concerning improved land-filling operations. G.R.

A81-47001 Radiation studies in the atmosphere (Radiatsionnye issledovaniia v atmosfere). Edited by K. Ia. Kondrat'ev and N. E. Ter-Markariants. Leningrad, Gidrometeoizdat (Glavnaia Geofizicheskaia Observatoriia, Trudy, No. 434), 1980. 151 p. In Russian.

Attention is given to such topics as the basic problems of the physics and chemistry of contemporary changes of climate, the Global Aerosol-Radiation Experiment (GAREX) of 1977, determination of effective values of the refractive index of atmospheric aerosol, algorithms for the effective evaluation of atmospheric transparence from lidar sounding, and angular anisotropy of reflection from snow cover and desert. Also considered are a method for the aerial measurement of integral fluxes of long-wave and short-wave radiation, statistical characteristics of the albedo of the earth-atmosphere system over the Atlantic, the effect of diffraction on the accuracy of absolute measurements of direct solar radiation, and an evaluation of the presence of aerosol in the atmosphere over the tropical Atlantic from measurements of direct solar radiation. F.G.M.

A81-47002 # Basic problems of the physics and chemistry of contemporary changes of climate (Osnovnye problemy fiziki i khimii sovremennykh izmenenii klimata). K. Ia. Kondrat'ev. In: Radiation studies in the atmosphere. Leningrad, Gidrometeoizdat, 1980, p. 3-14. 26 refs. In Russian.

The paper reviews various problems of the physics and chemistry of contemporary changes of global climate, associated with the influence of changes of atmospheric composition on radiation conditions and climate. Particular attention is given to the analysis of anthropogenic changes in the greenhouse effect. The possibilities of investigating climate parameters and the factors determining climate by means of space observations are briefly examined. F.G.M.

A81-47359 An atmospheric study by 'Spectrum-15' onboard of the Salyut-6 orbital station. D. Mishev (B'lgarska Akademiia na Naukite, Tsentralna Laboratoriia po Kosmicheski Izsledvaniia, Sofia, Bulgaria). *International Astronautical Federation, International Astronautical Congress, 32nd, Rome Italy, Sept. 6-12, 1981, Paper 81-120.* 10 p. 8 refs.

The multichannel spectrometer system, Spectrum-15, on board the Salyut-6 orbital station, is used to investigate the air pollution over large cities and industrial centers. The Spectrum-15 instrument has 15 channels, each bandwidth of which is not greater than 20 nm. It uses an objective width focus distance of 300 mm, a relative aperture of 1:4, and an angle-of-sight of 8 deg. The instrument is used in several study programs to define atmospheric transparency, determine aerosol indices of atmospheric scatter, and study the dependence of frequency on the atmospheric transfer function. The preliminary data processing of results from these investigations are presented in graphic form and interpreted. A list of the various program investigations carried out thus far is given, along with their corresponding dates and orbits as well as the cosmonaut who performed the study. J.F.

A81-47430 Potential for detection of natural disasters via Meteosat. A. Robson, J. Morgan (ESA, European Space Operations Centre, Darmstadt, West Germany), R. W. Herschy (Department of Transport/Department of the Environment, Water Data Unit, Reading, England), and J. Zschau (Kiel, Neue Universität, Kiel, West Germany). *International Astronautical Federation, International Astronautical Congress, 32nd, Rome, Italy, Sept. 6-12, 1981, Paper 81-262.* 19 p. 11 refs.

The use of Meteosat satellite capabilities in the detection of natural disasters is discussed. The satellites, which are positioned in geosynchronous orbit above the prime meridian, carry on imaging radiometer with coverage of a 65 deg great circle arc about the subsatellite point in one visible and two infrared channels every half hour. Disasters which may be observed by the radiometer system include hurricanes, extratropical depressions, drought situations and flooding; the resulting ground-processed images may then be distributed by the satellite to over 200 digital and analog receiving stations to be used in ameliorating the effects of the disasters. The Meteosat satellites are also part of a data collection system in which environmental sensors known as data collection platforms transmit data to the satellite on one of 66 reporting channels in the 402 MHz band and the satellite retransmits the data to the ground following conversion to the 1675 MHz band. The data collection platforms can be used to gather data in real time for purposes of water management and for applications in earth motion studies such as storm surge prediction and earthquake prediction. A.L.W.

A81-47433 Analysis of the November 23, 1980 earthquake as a design basis for satellite emergency communication. G. Berretta (ESA, Paris, France), P. Daly, H. Fromm, D. Tits (ESA, European Space Research and Technology Centre, Noordwijk, Netherlands), and S. Rossignoli (Fabbrica Italiana Apparecchiature Radioelettriche, Milan, Italy). *International Astronautical Federation, International Astronautical Congress, 32nd, Rome, Italy, Sept. 6-12, 1981, Paper 81-269.* 23 p. 12 refs.

The earthquake that occurred in Italy in November 1980 is discussed in order to show how satellites can be used for communication during emergencies. Five functions are identified where human intervention could reduce the consequences of earthquakes; these are predicting the occurrence of the earthquake, locating the earthquake focus, evaluating the damage and identifying life lines, localizing the survivors in need, and providing communications. Satellites are shown to be applicable in all these functions. It is proposed that a

Direct Television Broadcasting satellite be used for emergency communication. The features offered by this satellite are listed, among them the fact that the communications link to the area of the disaster is immediately available and that no installation with specialized personnel is required. It is also noted that the TV receiving antenna that would be used for emergency communication is already pointed toward the satellite. C.R.

A81-48682 # Dynamic ecosystem of the Aral Basin studied from satellite imagery (Dinamika ekosistem basseina Arala po materialam kosmofotos'emok). A. V. Sadov (Vsesoiuznyi Nauchno-Issledovatel'skii Institut Gidrogeologii i Inzhenernoi Geologii, Moscow, USSR). *Issledovanie Zemli iz Kosmosa,* July-Aug. 1981, p. 18-26. 12 refs. In Russian.

The possibilities and methods of studying changes in the environment of the Aral Basin and adjacent territories based on an analysis of satellite imagery are presented. The analysis is carried out by means of ecological interpretations, including the identification of the spatial boundaries of the ecosystem, an estimation of their stability to technogenetic effects, and the determination of their resulting changes. Satellite imagery is shown to be valuable for the construction of prognosis maps: an economic assessment of the territories involved is made and the probable lines of development of the anthropogenic process are plotted; this is used to construct prognosis maps of the evolution of the territory. J.F.

A81-49174 Satellite observations of England and northwestern Europe. J. L. Foster, J. P. Ormsby, and R. J. Gurney. *Weather,* vol. 36, Sept. 1981, p. 252-259. 8 refs.

The Heat Capacity Mapping Mission (HCMM) satellite, launched in April 1978 into a sun-synchronous orbit at an altitude of 620 km, acquired high-quality thermal infrared data suitable for studying the thermal properties of the terrestrial surface. HCMM data taken over England, Wales, and northwestern Europe on May 30, 1978 illustrate the effect of large urban areas on the weather and climate of the area. The urban heat island effect is evident, the larger cities being 10 K hotter than surrounding areas in the early afternoon. Many of the urban areas appear as dark areas of lower albedo, and well defined heat islands show as white blotches due to the higher surface temperature. The heat islands are much more distinct on the daytime thermal infrared images than on the nighttime images. Areas having a low building density and little or no industry are also detected on HCMM daytime thermal infrared imagery, since even a single block of buildings can start the process of heat island formation (Landsberg, 1970). Central business areas of London and the West Midlands are about 8 K warmer than their surrounding rural areas, but there is some systematic variation within each urban area, corresponding to local land use. J.F.

A81-49346 Determination of beach sand parameters using remotely sensed aircraft reflectance data. R. A. Shuchman (Michigan, Environmental Research Institute, Ann Arbor, MI) and D. K. Rea (Michigan, University, Ann Arbor, MI). *Remote Sensing of Environment,* vol. 11, Sept. 1981, p. 295-310. 16 refs. Research supported by the University of Michigan; Contracts No. N0014-74-C-0273; No. N0014-78-C-0458.

A81-49407 # The distribution of the trace gases H2O, NO2, and HNO3 in the middle atmosphere on the basis of LIMS measurements (Über die Verteilung der Spurengase H2O, NO2 und HNO3 in der mittleren Atmosphäre aus LIMS-Messungen). H. Fischer, C. Lüdecke (München, Universität, Munich, West Germany), and J. C. Gille (National Center for Atmospheric Research, Boulder, CO). *(Deutsche Meteorologen-Tagung und Internationales Alfred-Wegener-Symposium, Berlin, West Germany, Feb. 25-29, 1980.) Annalen der Meteorologie,* no. 15, 1980, p. 29-32. 7 refs. In German.

The trace gases H2O, NO2, and HNO3 are important factors in the photochemical reactions of the stratosphere. The Limb Infrared Monitor of the Stratosphere (LIMS) experiment was started to obtain global data for a detailed study of the chemistry-radiation-dynamics system of the atmosphere, taking into account the atmospheric region extending from the upper troposphere to the lower mesosphere. The LIMS instrument was placed on board of the polar Satellite Nimbus 7. A horizon-scanning procedure is employed in the studies. The current status of data evaluation is considered, giving attention to comparisons with ground truth data and the computer program for the evaluation of the satellite data. The obtained profiles for H2O, HNO3, and NO2 are shown. G.R.

A81-49431 # Aerosol sounding by means of aircraft-borne optical radar (Aerosolsondierung mittels Flugzeuglidar). P. Mörl, M. E. Reinhardt, and W. Renger (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für Physik der Atmosphäre, Oberpfaffenhofen, West Germany). *(Deutsche Meteorologen-Tagung und Internationales Alfred-Wegener-Symposium, Berlin, West Germany, Feb. 25-29, 1980.) Annalen der Meteorologie,* no. 15, 1980, p. 167, 168. 5 refs. In German.

Optical radar measurements conducted with the aid of aircraft provide the possibility to perform rapid surveys on a regional scale regarding the existence and location of atmospheric haze. Typical applications are related to the study of smog layers, and the survey of solid-particle pollutant emission in the case of great industrial complexes. Studies conducted by the German Meteorological Service make use of a Nd-YAG laser which provides 20-ns pulses at 1.064 and 0.532 micrometers. Operational data concerning the optical radar system are discussed, taking into account the backscattering profile produced by the laser pulse. Attention is also given to the auxiliary equipment, and aspects of data processing and evaluation. First results related to pilot missions are briefly considered. G.R.

A81-49433 # Comparative measurements of stratospheric CH4 and CO concentrations with spectrograph and correlation radiometers (Vergleichende Messungen stratosphärischer CH4- und CO-Konzentrationen mit Spektrograph und Korrelationsradiometern). D. Rabus and F. Fergg (München, Universität, Munich, West Germany). *(Deutsche Meteorologen-Tagung und Internationales Alfred-Wegener-Symposium, Berlin, West Germany, Feb. 25-29, 1980.) Annalen der Meteorologie,* no. 15, 1980, p. 171, 172. 5 refs. In German.

A81-49752 # The integration of remote sensing in environmental decision making for the Maritimes. A. C. Hamilton (New Brunswick, University, Fredericton, Canada). In: Canadian Symposium on Remote Sensing, 6th, Halifax, Canada, May 21-23, 1980, Proceedings. Ottawa, Canadian Aeronautics and Space Institute, 1981, p. 1-7.

An examination of the integration of remote sensing in decision-making for the Maritime environment shows that for basic land and ocean information the requirement is for sensors such as SAR that will reveal properties that hitherto were elusive or undetectable. For operational monitoring, the main requirement in addition to what is now routinely available is for dependable, frequent, weather-independent imagery. For management and policy decision-making there is an institutional requirement and a technical requirement. The institutional requirement is for better facilities to convert data to information and for decision-makers to learn the use of information interactively. The technical requirement is for finer and more dependable spectral resolution particularly for forestry, agriculture, and land classification. B.J.

A81-49759 # Multistage remote sensing in exploratory ecodistrict land classification. E. B. Wiken, T. W. Pierce, and G. R. Ironside (Environment Canada, Lands Directorate, Ottawa, Canada). In: Canadian Symposium on Remote Sensing, 6th, Halifax, Canada, May 21-23, 1980, Proceedings. Ottawa, Canadian Aeronautics and Space Institute, 1981, p. 63-71. 5 refs.

The Northern Land Use Information Series attempts to provide broad and consistent coverage of land resources in the Northwest Territories at a scale of 1:250,000. The map series includes an ecological overview of terrestrial ecosystems, the focus being the mapping and description of ecodistricts. The combined use of Landsat, aerial photographs, and 35 mm color slides has proved to be effective in the prefield, field, and postfield activities of the ecological land classification. The benefits have included improved map boundary definition and ecodistrict descriptions; reduced time, material, and manpower inputs; and improved field reconnaissance work through better direction to the various ecodistricts as well as to representative locales within each district. B.J.

A81-49773 # **Interpreter evaluations of airborne radar imagery for ecological and land/use cover classification in southern Manitoba.** C. D. A. Rubec (Environment Canada, Lands Directorate, Ottawa, Canada) and J. Cihlar (Canada Centre for Remote Sensing, Ottawa, Canada). In: Canadian Symposium on Remote Sensing, 6th, Halifax, Canada, May 21-23, 1980, Proceedings.
Ottawa, Canadian Aeronautics and Space Institute, 1981, p. 203-215. 6 refs.

Synthetic aperture radar images flown over two test areas in southwestern Manitoba were used successfully for classification and mapping of land cover, land use and general vegetation types. The criteria affecting interpretation success are similar to those commonly used with aerial photography. Radar images have specific patterns, shapes and associations that can be related to ground features. However, radar image tone and texture can present problems to interpreters. Experience with other types of images, and personal knowledge of the study area, all increase interpreter success with radar images. Summer X band, HH polarized images are the optimal source of synthetic aperture radar data for ecological and land use mapping applications in prairie regions of Canada. (Author)

A81-49781 # **Applications of remote sensing to construction impact assessment at the Roberts Bank Port, British Columbia.** G. F. Tomlins and K. P. B. Thomson (Canada Centre for Remote Sensing, Ottawa, Canada). In: Canadian Symposium on Remote Sensing, 6th, Halifax, Canada, May 21-23, 1980, Proceedings.
Ottawa, Canadian Aeronautics and Space Institute, 1981, p. 289-299. 18 refs.

A81-49783 # **Land use/cover mapping for Halifax County - Remote sensing alternatives.** N. A. Prout (Intera Environmental Consultants, Ltd., Ottawa, Canada). In: Canadian Symposium on Remote Sensing, 6th, Halifax, Canada, May 21-23, 1980, Proceedings. Ottawa, Canadian Aeronautics and Space Institute, 1981, p. 307-320. 12 refs.

A81-49788 # **Interpretation techniques applied to mixed terrains (Techniques d'interprétation appliquées aux terrains mixtes).** E. J. Langham (Environment Canada, National Hydrology Research Institute, Hull, Quebec, Canada), Y. Heymann (Société Française des Etudes et de La Recherche Economique et Statistique, France), and A. I. Rivard. In: Canadian Symposium on Remote Sensing, 6th, Halifax, Canada, May 21-23, 1980, Proceedings.
Ottawa, Canadian Aeronautics and Space Institute, 1981, p. 361-367. In French.

Results of the application of the supervised classification technique in conjunction with image color enhancement to land-use classification based on Landsat data obtained over a region previously studied by aerial photography and ground observations are presented. Data was obtained of the French department of Lot, a region composed of woods, pasture land, agricultural fields and vineyards. Due to the smallness of the fields and the mixture of vine and ground spectral signatures in a single area, it was found that nonsupervised classification of false-color images was unable to provide more than a general classification of land use. When principle component color enhancement is used together with the supervised classifier, it was possible not only to identify calcareous underbrush and other types of wooded terrains, but to distinguish vineyards from other crops. A.L.W.

A81-49790 # **Spectral measurement of rangeland.** K. P. B. Thomson, F. J. Ahern, R. J. Brown, K. Staenz (Canada Centre for Remote Sensing, Ottawa, Canada), D. H. McCartney, and J. Waddington (Department of Agriculture, Melfort, Saskatchewan, Canada). In: Canadian Symposium on Remote Sensing, 6th, Halifax, Canada, May 21-23, 1980, Proceedings. Ottawa, Canadian Aeronautics and Space Institute, 1981, p. 377-386. 6 refs.

A project carried out by the Canada Centre for Remote Sensing during the summer of 1979 at the Experimental Rangeland Site near Pathlow, Saskatchewan in which the biomass/spectral reflectance relationship was addressed is discussed. It is noted that this site is representative of the rangeland under current use in Saskatchewan. The remote sensing data comprised Landsat MSS data (July 27 and September 19) and airborne multispectral scanner data (July 27 and September 14). Analysis of the data was found to show good correlations between Landsat MSS parameters and green biomass in the July period but not in September. Similar results were obtained for the Thematic Mapper Bands, which were simulated from the airborne MSS data. C.R.

A81-49792 # **Remote sensing and land use planning.** P. S. T. Lee (U.S. Department of Agriculture, Remote Sensing Branch, Washington, DC). In: Canadian Symposium on Remote Sensing, 6th, Halifax, Canada, May 21-23, 1980, Proceedings.
Ottawa, Canadian Aeronautics and Space Institute, 1981, p. 397-403. 8 refs.

Changes in land use were measured in Central Arizona using sensing techniques, and a framework was developed to provide timely information on land use planning purposes. A land use classification system is presented, which defines major land use categories as agricultural land; urban or build-up land; range, forest and barren land; and water. Landsat data are registered and digitized to estimate acreages of changes for various land use classes. Total acreages or urban land have increased from 136 thousand acres in 1972, to 304 thousand acres in 1979, representing a 122% increase; 65% of which comes from range and other land, and 35% of which comes from formerly agricultural land. About 55,000 acres of rangeland have been converted to farmland due to more water irrigation; however, this does not offset the loss of agricultural land to urban expansion, and a net loss of 15,000 acres of farmland and 186,000 acres of rangeland is found in Maricopa county. D.L.G.

A81-49798 # **Landsat data as a basis for regional environmental assessment within the Columbia Plateau.** L. S. Leonhart (Rockwell International Corp., Richland, WA) and J. G. Stephan (Battelle Pacific Northwest Laboratories, Richland, WA). In: Canadian Symposium on Remote Sensing, 6th, Halifax, Canada, May 21-23, 1980, Proceedings. Ottawa, Canadian Aeronautics and Space Institute, 1981, p. 459-471.

It is pointed out that initial assessments of the area involved classification of four contiguous Landsat scenes recorded during the summer of 1975 and about 300 1978 high-altitude (U-2) photographs. The mosaic thus obtained was segregated into ten land-cover classes. The classified land-cover data were machine-integrated with digital irrigation well-location data obtained from the U.S. Geological Survey's Ground-Water Site Inventory. The resulting ground-water multisource data product was required by hydrologists in order to segregate potential artificial recharge areas from artificial groundwater discharge areas. It is noted that related studies have employed Landsat data and aerial imagery to identify linear structures and other geologic features which may have a significant bearing on the tectonic and/or hydrologic setting to the Columbia Plateau. C.R.

A81-49803 # **Resource inventory and terrain analysis in north western Manitoba from integrated remote sensing data.** V. H. Singhroy (J. D. Mollard and Associates, Ltd., Regine, Saskatchewan, Canada) and R. Dixon (Manitoba Remote Sensing Centre, Winnipeg, Canada). In: Canadian Symposium on Remote Sensing, 6th, Halifax, Canada, May 21-23, 1980, Proceedings. Ottawa, Canadian Aeronautics and Space Institute, 1981, p. 513-523. 10 refs.

It is noted that continued growth in northern Manitoba communities demands the acquisition and compilation of data pertaining to the regional resource potential of large areas. In the majority of cases, planners, resource managers, and environmental consultants are faced with the problem of limited and scattered data which inhibit comprehensive regional planning. A simple integrated approach and techniques involved in using multistage remote sensing data in the production of a regional resource base map are demonstrated. Enhanced Landsat data, black and white, color infrared and thermal infrared photographs are used to generate regional vegetation and terrain geology maps prior to field investigation. Field sampling verifies the accuracy of the units identified and produces a valuable data base for detailed analysis and planning. C.R.

A81-49806 # **Current resource mapping and environmental monitoring applications using Landsat MSS data in Scotland.** G. C. Stove (MacAuley Institute for Soil Research, Aberdeen, Scotland) and K. E. Bagot (Royal Aircraft Establishment, Farnborough, Hants., England). In: Canadian Symposium on Remote Sensing, 6th, Halifax, Canada, May 21-23, 1980, Proceedings. Ottawa, Canadian Aeronautics and Space Institute, 1981, p. 551-557.

Photogrammetric digital mapping facilities and the advanced, IDP3000 image analyzer are used to enhance and measure a variety of peatland and land cover types, leading to the compilation of a 1:100,000-scale Peat Resource and Land Cover Map of the Isle of Lewis. Further development of multispectral classification techniques based on stretched band ratios for selective terrain features has resulted in the compilation of a land use/land cover map of the Buchan area of northeast Scotland. In addition, optimizing the stretched band intensity differences by means of principal components analysis has made it possible to distinguish between phytoplankton blooms, coastal sediment re-circulation patterns and submerged coastal and river-mouth bars. A similar enhancement technique outlines mountain snow cover and distinguishes between cloud and snow. O.C.

N81-29496*# National Aeronautics and Space Administration. Earth Resources Labs., Bay St. Louis, Miss.
EVALUATION OF MULTIBAND, MULTITEMPORAL, AND TRANSFORMED LANDSAT MSS DATA FOR LAND COVER AREA ESTIMATION
E. R. Stoner, G. A. May (Dept. of Agriculture, Houston, Tex.), and M. T. Kalcic, Principal Investigators Apr. 1981 25 p refs Sponsored by NASA, USDA, Dept. of Commerce, Dept. of the Interior, and Agency for International Development ERTS (Proj. AgRISTARS)
(E81-10161; NASA-TM-82289; DC-Y1-04089; NSTL/ERL-196) Avail: NTIS HC A02/MF A01 CSCL 02C

Sample segments of ground-verified land cover data collected in conjunction with the USDA/ESS June Enumerative Survey were merged with LANDSAT data and served as a focus for unsupervised spectral class development and accuracy assessment. Multitemporal data sets were created from single-date LANDSAT MSS acquisitions from a nominal scene covering an eleven-county area in north central Missouri. Classification accuracies for the four land cover types predominant in the test site showed significant improvement in going from unitemporal to multitemporal data sets. Transformed LANDSAT data sets did not significantly improve classification accuracies. Regression estimators yielded mixed results for different land covers. Misregistration of two LANDSAT data sets by as much and one half pixels did not significantly alter overall classification accuracies. Existing algorithms for scene-to scene overlay proved adequate for multitemporal data analysis as long as statistical class development and accuracy assessment were restricted to field interior pixels. A.R.H.

N81-29517# California Univ., Livermore. Lawrence Livermore Lab. Environmental Sciences Div.
REMOTE SENSING OF SOIL RADIONUCLIDE FLUXES IN A TROPICAL ECOSYSTEM
B. Clegg, J. Koranda, W. Robinson, and G. Holladay 6 Nov. 1980 7 p refs Submitted for publication
(Contract W-7405-eng-48)
(UCRL-84501) Avail: NTIS HC A02/MF A01

A transponding geostationary satellite is being used to collect surface environmental data to describe the fate of soil-borne radionuclides. The remote, former atomic testing grounds at the Eniwetok and Bikini Atolls present a difficult environment in which to collect continuous field data. Land-based, solar-powered microprocessor and environmental data systems remotely acquire measurements of net and total solar radiation, rain, humidity, temperature, and soil-water potentials. For the past year, the water flux model predicts wet season plant transpiration rates nearly equal to the 6 to 7 mm/d evaporation pan rate, which decreases to 2 to 3 mm/d for the dry season. Radioisotopic analysis confirms the microclimate-estimated 1:3 to 1:20 soil to plant dry matter concentration ratio. This ratio exacerbates the dose to man from intake of food plants. Nephelometer measurements of airborne particulates presently indicate a minimum respiratory radiological dose. DOE

N81-30656 Institut d'Aeronomie Spatiale de Belgique, Brussels.
ATMOSPHERIC NITRIC ACID AND CHLOROFLUOROMETHANE 11 FROM INTERFEROMETRIC SPECTRA OBTAINED AT THE OBSERVATOIRE DU PIC DU MIDI
C. Lippens and C. Muller 1980 31 p refs Submitted for publication
(Aeronomica-Acta-A-227-1980) Avail: Issuing Activity

A modified interferometer was used to obtain absorption spectra and emission spectra (reduced from the difference between the reference spectrum and transformed emission data). The data obtained lead to a value of 12 billion mol/cu cm nitric acid at an altitude of 22km; chlorofluoromethane 11 is found in the troposphere at 148 + or - 12ppt. No evidence of peroxy nitric acid, nitrous acid or ammonia was observed. The difficulties in observing hydrogen peroxide and obtaining accurate values for ozone and chlorofluoromethane 12 are discussed. The integrated peroxynitric acid column is found to be smaller than 10 to the 15th power mol/sq cm. Author (ESA)

N81-30695# Pennsylvania State Univ., University Park. Dept. of Meteorology.
ENVIRONMENTAL MEASUREMENTS OF POWER PLANT COOLING TOWER AND STACK PLUMES Final Report
D. W. Thomson, ed., R. G. dePena, ed., and J. A. Pena, ed. 1981 180 p refs
(Contracts DE-AS02-76EV-02463; AT(11-1)-2463; E(11-1)-2463)
(DOE/EV-02463/6) Avail: NTIS HC A09/MF A01

The focus of this program was to establish the reality and magnitude of any environmental changes caused by the plumes from large evaporative cooling towers through a comprehensive set of measurements taken from a research aircraft. Results are divided into three sections: structure and dynamics of cooling tower plumes; chemical transformation of SO2 to sulfates in coal-fired power plant plumes; and drift deposition studies. DOE

N81-31680*# Science Applications, Inc., La Jolla, Calif.
SATELLITE MEASUREMENTS OF TROPOSPHERIC AEROSOLS Final Report
M. Griggs Aug. 1981 64 p refs
(NASA-CR-3459; SAI-131-80-578-LJ) Avail: NTIS HC A04/MF A01 CSCL 13B

This investigation uses LANDSAT 2 radiance data and ground-truth measurements of the aerosol optical thickness, obtained previously from five inland sites, to study the usefulness and limitations of the near infrared radiance over inland bodies of water. The linear relationship between LANDSAT 2 MSS7 and aerosol content found in this study can be used to estimate the aerosol content with a standard deviation of 0.42N. Analysis of the data for MSS6 and MSS7 suggest that the larger uncertainty is mostly due to water turbidity, with little contribution from the adjacency effect. The relationship found is best applied to determine an average aerosol content over a period of time at a given target, or an area average at a given time over several targets close together. Author

N81-32581*# Aerospace Corp., El Segundo, Calif. Electronics Research Lab.
MILLIMETER-WAVE SENSING OF THE ENVIRONMENT: A BIBLIOGRAPHIC SURVEY
E. Schneider and E. E Epstein 29 May 1981 308 p
(Contract NAS6-2960)
(NASA-CR-156879; ATR-81-(7805-1)) Avail: NTIS HC A14/MF A01 CSCL 13B

This literature survey was conducted to examine the field of millimeter wave remote sensing of the environment and collect all relevant observations made in the atmospheric windows near 90, 140, and 230 GHz of ocean, terrain, man-made features, and the atmosphere. Over 170 articles and reports were examined; bibliographic references are provided for all and abstracts are quoted when available. Selected highlights were extracted from the pertinent articles. T.M.

N81-32586# Army Engineer Topographic Labs., Fort Belvoir, Va.
REMOTE SENSING FOR ENGINEERING SITE SELECTION
Jack N. Rinker and Robert E. Frost 13 May 1981 15 p refs
(AD-A102810; ETL-R018) Avail: NTIS HC A02/MF A01 CSCL 14/5

For any significant construction, e.g., airstrip, bridge, dam, powerplant, industrial park, canal, etc., there is the first phase of site selection and evaluation. One goal of this phase is to obtain information about surficial materials (granular, cohesive, permeable, nonuniform, etc.), thickness of the soil mantle, nature of the bedrock, drainage, presence of unstable materials and conditions, presence of subsurface solution cavities, fractures, joints, faults, etc. Remote sensing techniques in the form of manual analysis of photo index sheets and LANDSAT for regional information, and of stereo aerial photography for local details,

provides an economical and rapid means of obtaining this first assessment. An experienced team can quickly produce surficial geology/soils maps, drainage maps, land use/land cover maps, etc., highlight potential problem areas, select preferred sites and alternates, and indicate probable impacts on the environment of any given action. This image-derived information sets the basis for establishing a logical ground sampling program, and provides the framework for correlating a large variety of information. As yet, it is not possible to provide very much of this needed terrain information by digital, or automatic, image analysis procedures. Author (GRA)

N81-32708*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

NASA PARTICIPATION IN THE 1980 PERSISTENT ELEVATED POLLUTION EPISODE/NORTHEAST REGIONAL OXIDANT STUDY (PEPE/NROS) PROJECT: OPERATIONAL ASPECTS

G. L. Maddrea, Jr. and R. J. Bendura Sep. 1981 136 p refs (NASA-TM-83170; L-14584) Avail: NTIS HC A07/MF A01 CSCL 13B

A field experiment designed to further understand the formation and transport of visibility reducing aerosols and to characterize regional scale air masses and urban plumes is described. Measurements were made primarily in the Ohio River Valley region. The NASA participation included obtaining measurements for the determination of mixing layer height and ozone profiles by using airborne remote sensor systems such as the ultraviolet differential absorption lidar, the high spectral resolution lidar, and the laser absorption spectrometer. Other NASA systems included the microwave atmospheric remote sensor, tethered balloons, an in situ measurements aircraft, and several photometer/transmissiometer systems. T.M.

N81-33720# Science Applications, Inc., La Jolla, Calif. Electronics Vision and Systems Div.

SATELLITE MEASUREMENTS OF ATMOSPHERIC AEROSOLS Annual Report, 15 Nov. 1980 - 26 Aug. 1981

M. Griggs 26 Aug. 1981 21 p refs (Contract N00014-77-C-0489) (AD-A103493; SAI-131-81-275-LJ) Avail: NTIS HC A02/MF A01 CSCL 04/1

Analysis of NOAA-6 AVHRR data and ground-truth measurements at two locations has found a radiance-aerosol content relationship which agrees very well with that previously determined for LANDSAT 2 Data. A new technique was developed to use AVHRR Channels 1 and 2 radiances to infer aerosol size distribution information, in addition to the optical thickness. The technique was successfully tested with a small data set obtained in a ground-truth experiment on the USNS Hayes. Author (GRA)

03

GEODESY AND CARTOGRAPHY

Includes mapping and topography.

A81-42554 # **Analysis of the geometry of a frame photograph (K analizu geometrii kadrovogo fotosnimka).** V. G. Tarakanov (Leningradskoe Vysshee Voenno-Topograficheskoe Komandnoe Uchilishche, Leningrad, USSR). *Geodeziia i Aerofotos'emka,* vol. 1, 1981, p. 82-86. In Russian.

A principle of surface mapping is developed for describing the basic geometric relationships of frame photographs. In particular, the principle can be used to obtain relationships between the coordinate points of a region and image coordinate points on aerial photographs in addition to scale formulas for aerial photographs. The proposed mapping principle (and methods for the description of single photos and stereopairs that derive from this principle) is characterized by relative simplicity, universality, and efficiency. B.J.

A81-42556 # **The use of spaceborne photography for topographic mapping (Ispol'zovanie kosmicheskikh snimkov pri topograficheskom kartografirovanii).** T. V. Vereshchaka (Moskovskii Institut Inzhenerov Geodezii, Aerofotos'emki i Kartografii, Moscow, USSR). *Geodeziia i Aerofotos'emka,* vol. 1, 1981, p. 95-102. In Russian.

Various aspects of the application of spaceborne photography to topographic mapping are considered. Spaceborne photography is found to be useful in such tasks as the systematic analysis of terrain changes, the interpretation of aerial photographs for the compilation and modification of topographic maps, and the editing of topographic maps. Spaceborne photography is also considered in relation to the formation of systems of conditional markings, and the geographic principles underlying combinations of conditional markings. B.J.

A81-42846 # **Measurement of lengths, angles, and areas on the earth's spheroid (Izmerenie dlin, uglov i ploshchadei na zemnom sferoide).** V. I. Khizhnichenko. *Geodeziia i Kartografiia,* May 1981, p. 6-8. In Russian.

In order to evaluate geometrical distortions of images obtained by satellite television systems, it is necessary to know the lengths, areas, and angles of triangles specified by three points on the surfaces of the spheroidal earth. This paper presents approximate formulas for calculating the lengths, angles, and areas of spheroidal triangles, whose vertices are specified by geographic coordinates. The analysis is carried out relative to auxiliary angular coordinates on a single sphere; the resulting formulas are obtained with allowance for the ellipsoidality of the spheroid. This method was successfully used to evaluate geometrical distortions of images of the earth's surface obtained by the Meteor-Priroda space system. B.J.

A81-42847 # **Topographic and cartographic applications of photogrammetry (O topograficheskom i kartograficheskom primenenii fotogrammetrii).** N. V. Sukhot'ko. *Geodeziia i Kartografiia,* May 1981, p. 52-55. In Russian.

Papers concerning the topographic and cartographic applications of photogrammetry presented at the 16th congress of the International Photogrammetry Society (July 1980) are briefly reviewed. Particular consideration is given to the compilation of detailed digital maps and the cartographic processing of digital data; the improvement and refinement of topographic maps; general large-scale mapping with the aim of urban and rural planning; mapping using satellite remote sensing systems; orthophototransformation and photomapping; pollution mapping; and the general mapping of earth resources. Basic directions in the development of photogrammetry are described. P.T.H.

A81-43524 # **Gravimetric studies of the earth's crust in the oceans (Gravimetricheskie issledovaniia zemnoi kory okeanov).** A. G. Gainanov. Moscow, Izdatel'stvo Moskovskogo Universiteta, 1980. 240 p. 271 refs. In Russian.

Methods of marine gravimetry are described, and maps of the gravity anomalies in the Pacific, Atlantic, and Indian Oceans are presented and described. Gravimetric and seismic data were used to construct density models of the oceanic crust, as well as of the lithosphere of mid-oceanic ridges, trenches, and continental margins. In addition, the use of gravimetry to survey for petroleum resources in the ocean is considered. B.J.

A81-45427 * **An examination of spectral band ratioing to reduce the topographic effect on remotely sensed data.** B. Holben and C. Justice (NASA, Goddard Space Flight Center, Earth Resources Branch, Greenbelt, MD). *International Journal of Remote Sensing,* vol. 2, Apr.-June 1981, p. 115-133. 33 refs.

Spectral-band ratioing of radiance data is examined as a means of reducing the topographic effect in multispectral data. A ground-based nadir-pointing two-channel radiometer filtered for the red and photographic IR portions of the spectrum was used to measure the topographic effect associated with a uniform surface inclined from horizontal to 60 deg at 16 compass points and for several solar elevations. It is found that ratioing reduced the topographic effect in the field-measured radiance data by an average of 83%, that the remaining topographic effect could be further reduced by subtracting the scattered-light component of the global irradiance before ratioing, and that ratioing was not effective in reducing the topographic effect on shaded surfaces illuminated solely by scattered light. It is concluded that additional variations in ratios can be expected for Landsat data owing to sensor calibration and quantization. F.G.M.

A81-45828 * # **Orbit determination requirements for TOPEX.** B. D. Tapley, B. E. Schutz, J. Ries, G. Rosborough (Texas, University, Austin, TX), and G. H. Born (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA). *American Astronautical Society and American Institute of Aeronautics and Astronautics, Astrodynamics Specialist Conference, Lake Tahoe, NV, Aug. 3-5, 1981, AAS Paper 81-158.* 30 p. 15 refs.

The error sensitivity of orbit calculations in support of the NASA Ocean Surface Topography Mapping Experiment (TOPEX), which require an accuracy on the order of 5 cm, is investigated. The contributions of errors in the gravitational, atmospheric drag and solar radiation pressure models to the computed orbit are analyzed for the cases of an ideal data distribution and realistic laser ranging data coverage. It is found that the major contributor to radial orbital error is the error in the geopotential model, accounting for orbital errors of 30 to 70 cm, with the effects of solar radiation pressure, drag modeling, tracking station coordinate errors making lesser contributions. It is concluded that TOPEX accuracy goals cannot be met using ground-based laser ranging data without improving the geopotential model. A.L.W.

A81-46678 **Stereoorthophotos as aids in the mapping of high mountain regions (Stereoorthophotos als Hilfsmittel der Hochgebirgskartierung).** R. Finsterwalder (München, Technische Universität, Munich, West Germany). *Bildmessung und Luftbildwesen,* vol. 49, Sept. 1, 1981, p. 161-164. 7 refs. In German.

The appropriate representation of the characteristics of high mountain regions is very difficult. Contour lines, for instance, cannot adequately show sharp edges and discontinuities present in mountainous terrain. The difficulties can be reduced by making use of orthophotos. Finsterwalder (1972) and Pillewizer (1976) have conducted studies in this direction, taking into account orthophotos which could not be viewed stereoscopically. However, the third dimension is in mountainous areas especially important for the interpretation of aerial photographs. The use of a second orthophoto makes it now possible to view orthophotos also stereoscopically, and to obtain, thereby, additional information for the map-plotting procedure. Attention is given to the production of stereoorthophotos, the study of the two orthophotos and the contour line image in the stereoscope, and the drawing procedure. The implementation of the considered method is illustrated with the aid of three examples involving stereo models. G.R.

A81-47938 # **Differential Doppler experiment /DIDEX/ for geodetic applications.** J. Kazmierski (Instytut Lotnictwa, Warsaw, Poland), J. Latka, and J. B. Zielinski (Polska Akademia Nauk, Centrum Badan Kosmicznych, Warsaw, Poland). In: Scientific and engineering uses of satellite radio beacons; Proceedings of the

Symposium, Warsaw, Poland, May 19-23, 1980. (A81-47901 23-46) Warsaw, Panstwowe Wydawnictwo Naukowe, 1981, p. 443-448.

The proposed DIDEX (Differential Doppler Experiment) of the Intercosmos program uses a mother spacecraft and two subsatellites to measure the Doppler shift of a two-way microwave radio signal. The space vehicles have an altitude of about 300 km and an orbital plane inclination of 85 deg. The two-way Doppler shift is measured by transmitting a known signal to the two subsatellites from the mother spacecraft and coherently transponding the observed signal back to the reference system. The reference oscillator generates a 10 MHz signal stable to one part in 10 to the 11th over a 1-100 sec interval. The receivers are of the phase-locked type; the phase-locked loops have 5 Hz noise bandwidths which are broadened to 50 Hz during signal acquisition. An accuracy of 0.05 mm/sec for velocity measurements is required, and a signal frequency of 3-5 GHz is used. The influence of the ionosphere on measurement accuracy is considered when (1) the mother spacecraft moves in a homogeneous ionosphere with a velocity difference between the two subsatellites and (2) the mother satellite moves in an ionosphere with a horizontal gradient electron concentration. The DIDEX procedure is shown to correct measurement errors, taking into account only the first term containing the influence of the ionosphere. J.F.

A81-48678 # **Optimization of Doppler measurements in the satellite network of Eastern Europe (Optimizatsiia Dopplerovskikh izmerenii v kosmicheskoi seti Vostochnoi Evropy).** Ts. Gergov and N. Georgiev (B'lgarska Akademiia na Naukite, Tsentralna Laboratoriia po Vissha Geodeziia, Sofia, Bulgaria). *Vissha Geodeziia,* no. 7, 1981, p. 13-19. 5 refs. In Russian.

Photographic observations and optimal Doppler observations from the Intercosmos program were used in a modeling study to determine the feasibility of constructing a three-dimensional geodetic network. Optimal Doppler measurements were assessed in an effort to obtain the highest accuracy in the determination of station coordinates. It is found that a three-dimensional network of satisfactory geodetic accuracy cannot be established on the basis of only Doppler measurements of earth chord length. Network accuracy is increased by the inclusion of the orienting elements Lambda and Phi of the earth chords, defined by available photographic observations in conjunction with Doppler measurements. B.J.

A81-48679 # **A 'meteorological' method for calculating vertical refraction (O 'meteorologicheskom' metode ucheta vertikal'noi refraktsii).** O. A. Mozzhukhin (Gor'kovskii Inzhenerno-Stroitel'nyi Institut, Gorki, USSR). *Vissha Geodeziia,* no. 7, 1981, p. 57-63. 8 refs. In Russian.

Attention is given to the so-called meteorological method for assessing the influence of refraction in geodetic leveling. The theoretical background and experimental verification of the method are discussed along with its limits of application. Empirical ratios of systematic and random errors due to refraction are obtained for geodetic measurements as a function of distances to the observation points. B.J.

A81-48696 # **Lineaments - Problems and directions of studies by means of aerial and space tools and methods (Lineamenty - Problemy i napravleniia issledovanii s pomoshch'iu aerokosmicheskikh sredstv i metodov).** V. I. Makarov. *Issledovanie Zemli iz Kosmosa,* July-Aug. 1981, p. 109-115. 35 refs. In Russian.

Divergences of opinion existing among investigators of lineaments are examined. Problems involving the definition, origin, age, classification, and depth of lineaments, and their relationship to planetary fracture systems are examined. Emphasis is placed on the use of remote sensing methods to study lineaments. B.J.

A81-49811 # **Generation and use of digital elevation data for large areas.** P. J. Letts (DIPIX Systems, Ltd., Ottawa, Canada) and G. Rochon (Université Laval, Quebec, Canada). In: Canadian Symposium on Remote Sensing, 6th, Halifax, Canada, May 21-23, 1980, Proceedings. Ottawa, Canadian Aeronautics and Space Institute, 1981, p. 597-602.

It is noted that while the integration of topographical data in the analysis of remotely sensed images has several advantages, technical difficulties often make this operation impracticable. On the basis of contours digitized from standard cartographic maps, a new approach to the generation of a digital terrain model is presented, along with the use of these data in the transformations of satellite-measured radiances. It is thus possible to modify the radiances either as a function of the ground solar illumination or of the look angles of the satellite, or even of the reflection characteristics of the observed surfaces. C.R.

N81-30496*# Phoenix Corp., McLean, Va.
SPACE BASED TOPOGRAPHIC MAPPING EXPERIMENT USING SEASAT SYNTHETIC APERTURE RADAR AND LANDSAT 3 RETURN BEAM VIDICON IMAGERY Final Report
Gerald L. Mader 20 Jul. 1981 35 p refs Prepared for JPL (Contract JPL-955998)
(NASA-CR-164675; JPL-9950582) Avail: NTIS HC A03/MF A01 CSCL 08B

A technique for producing topographic information is described which is based on same side/same time viewing using a dissimilar combination of radar imagery and photographic images. Common geographic areas viewed from similar space reference locations produce scene elevation displacements in opposite direction and proper use of this characteristic can yield the perspective information necessary for determination of base to height ratios. These base to height ratios can in turn be used to produce a topographic map. A test area covering the Harrisburg, Pennsylvania region was observed by synthetic aperture radar on the Seasat satellite and by return beam vidicon on by the LANDSAT - 3 satellite. The techniques developed for the scaling re-orientation and common registration of the two images are presented along with the topographic determination data. Topographic determination based exclusively on the images content is compared to the map information which is used as a performance calibration base. A.R.H.

N81-30505# Los Alamos Scientific Lab., N. Mex.
SEASAT SATELLITE INVESTIGATION OF THE STRUCTURE OF WESTERN NEBRASKA AND ITS APPLICATION TO THE EVALUATION OF GEOTHERMAL RESOURCES
J. Stix 1981 20 p refs Presented at the Intern. Symp. of Remote Sensing of Environ., Ann Arbor, Mich., 11-15 May 1981
(Contract W-7405-eng-36)
(LA-UR-81-1454; CONF-810557-1) Avail: NTIS HC A02/MF A01

Seasat synthetic aperture radar (SAR) satellite imagery was used to interpret the structural framework and the geothermal potential of an area in western Nebraska. Lineaments were mapped from the imagery and then compared to known structure. It was found that Seasat does record surface manifestations of subtle basement structures, particularly faulting. Four areas with geothermal potential were delineated using Seasat and other data. It is concluded that Seasat imagery is a useful reconnaissance exploration tool in the interpretation of regional structure within areas of little topographic relief. DOE

N81-31601*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
SATELLITE TO SATELLITE DOPPLER TRACKING (SSDT) FOR MAPPING OF THE EARTH'S GRAVITY FIELD Final Report, 1 Apr. 1980 - 31 Mar. 1981
G. Colombo, E. M. Gaposchkin, and M. Grossi Sep. 1981 107 p refs
(Grant NAG5-36)
(NASA-CR-164722) Avail: NTIS HF A06/MF A01 CSCL 08G

Two SSDT schemes were evaluated: a standard, low-low, SSDT configuration, which both satellites are in basically the same low altitude nearly circular orbit and the pair is characterized by small angular separation; and a more general configuration in which the two satellites are in arbitrary orbits, so that different configurations can be comparatively analyed. The standard low-low SSDT configuration is capable of recovering 1 deg X 1 deg surface anomalies with a strength as low as 1 milligal, located on the projected satellite path, when observing from a height as large as 300 km. The Colombo scheme provides an important complement of SSDT observations, inasmuch as it is sensitive to radial velocity components, while keeping at the same performance level both measuring sensitivity and measurement resolution. T.M.

N81-31604*# GeoScience Research Corp., Salisbury, Md.
TERRAIN PROFILING FROM SEASAT ALTIMETRY
R. L. Brooks Mar. 1981 59 p refs Sponsored by NASA, National Geodetic Survey and USGS
(NASA-CR-156878) Avail: NTIS HC A03/MF A01 CSCL 08B

To determine their applicability for terrain profiling, Seasat altimeter measurements were analyzed for the following geographic areas: (1) Andean salars of southern Bolivia; (2) Alaska; (3) south-central Arizona; (4) imperial Valley of California; (5) Yuma Valley of Arizona; and (6) Great Salt Lake Desert. Analysis of the data over all of these geographic areas shows that the satellite altimeter servo did not respond quickly enough to changing terrainn features. However, it is demonstrated that retracking of the archived surface return waveforms yields surface elevations over smooth terrain accurate to + or - 1 m when correlated with large scale maps. The retracking algorithm used and its verification over the salars of southern Bolivia are described. Results are presented for each of the six geographic areas. A.R.H.

N81-32574*# Wisconsin Univ., Madison.
INVESTIGATION OF ANTARCTIC CRUST AND UPPER MANTLE USING MAGSAT AND OTHER GEOPHYSICAL DATA Quarterly Status Technical Progress Report
C. R. Bentley, Principal investigator 4 Mar. 1981 1 p ERTS (Contract NAS5-25977)
(E81-10113; NASA-CR-164107; QSTPR-4) Avail: NTIS HC A02/MF A01 CSCL 09B

The compatibility of Univac-formatted tapes with the in-house computer was investigated and a decision was made to switch to IBM-formatted tapes. A NASA software package was adapted for use with data when they become available. Auxiliary geophysical and geological data and literature continue to be compiled and studied so that when data tapes arrive, real analysis may begin. A.R.H.

N81-33522# Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
POSITION MEASUREMENTS IN COLOMBIA BY MEANS OF SATELLITE OBSERVATIONS [POSITIONSBESTIMMUNGEN IN KOLUMBIEN MITTELS SATELLITENBEOBACHTUNGEN]
Walter Etling *In its* Rept. on Cartography and Geodesy, Ser. 1: Original Rept., No. 80 1980 p 5-11 In GERMAN; ENGLISH summary
Avail: NTIS HC A05/MF A01

A number of positions on the Earth were determined by means of Doppler measurements using the Navy navigation satellite system in support of a seismic measurement compaign conducted in Colombia. The transformation of the initial geocentric system to the required terrestrial coordinate systems is discussed. It is shown that the positions of the points to be measured can be determined with an accuracy sufficient for cartographic purposes using only a restricted number of satellite passages. Experimentation under conditions pertaining to Colombia is also commented on. Author (ESA)

N81-33525# Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
OVSUP: A PROGRAM FOR COMPUTER-AIDED DISENTANGLEMENT OF OVERLAPPING ZONES [OVSUP: EIN PROGRAMM ZUR EDV-GESTUETZTEN ENTFLECHTUNG DER UEBERLAPPUNGSSTELLAN VERBREITER LINIENHAFTER KARTENELSENENTE]
Roland Schittenhelm *In its* Rept. on Cartography and Geodesy, Ser. 1: Original Rept., No. 80 1980 p 75-82 refs In GERMAN; ENGLISH summary

Avail: NTIS HC A05/MF A01

A computer program (OVSUP) was developed to disentangle overlapping zones of broadened cartographic line elements by computing the amount of displacement of single points. OVSUP is run in combination with a subroutine OVPREC which finds the beginning and the end of such overlapping zones automatically. A survey is made of the program structure, the functioning of its subroutines, and the conditions for application. The computer output is in the form of a vector containing the coordinates of the displaced points. A practical application illustrates the procedure. Author (ESA)

N81-33526# Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
PHOTOGRAMMETRY IN CHINA
Zhi-zhou Wang (Wuhan Coll. of Geodesy, Photogrammetry and Cartography, China) *In its* Rept. on Cartography and Geodesy, Ser. 1: Original Rept., No. 80 1980 p 83-89 In GERMAN; ENGLISH summary

Avail: NTIS HC A05/MF A01

Past and present developments in China in the field of photogrammetry and survey are summarized. The production of topographic maps at scales 1 : 100,000 and 1 : 50,000 produced by topogrammetic techniques is discussed. Base map production at scale 1 : 10,000 using aerial imagery, analytical block adjustment, computer bundle adjustment, and preliminary orthophoto production is described. Photogrammetric research on digital correlation of stereophotography on production and application of digital terrain models, and on geometrical remote sensing data processing are treated. Author (ESA)

N81-33527# Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
REPORTS ON CARTOGRAPHY AND GEODESY, SERIES 1: ORIGINAL REPORTS, NUMBER 81 [NACHRICHTEN AUS DEM KARTEN- UND VERMESSUNGSWESEN, REIHE 1: ORIGINALBEITRAERE]
1980 134 p refs In GERMAN; ENGLISH summary Original contains color illustrations
(ISSN-0469-4236) Avail: NTIS HC A07/MF A01

The application of automatic data processing to cartography is discussed. Software development, with contributions to object extraction, network synthesis, graphical kernel systems, and height model construction is considered. Configuration descriptions of global cartographic data base systems and applications in the fields of geological surveys, electrical supply grids, and marine navigation are presented.

N81-33578# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Engineering.
AN EVALUATION OF DETAIL IN DYNAMIC VISUAL DISPLAYS M.S. Thesis
Mary A. Smart 1 Dec. 1980 111 p refs
(AD-A103378; AFIT/GCS/EE/80-14) Avail: NTIS HC A06/MF A01 CSCL 09/2

This report has its basis in the Airborne Electronic Terrain Mapping System (AETMS), an aircraft mapping system based on an idea proposed by L.A. Tamburino and developed by the Air Force Avionics Laboratory. A constantly changing background provides the basis for an interesting investigation on the hypothesis that a dynamic background will distract the operator's attention away from important details on the display. The software developed provides an overlay of symbols onto the terrain map generated by the AETMS and is contained in this report. A symbol and color set is suggested for the AETMS. An experiment to determine a master symbol and color set is suggested. The experiment suggests using both simple vector symbols and Fourier transformed symbols to help define the master set.
Author (GRA)

N81-33581# Analytic Sciences Corp., Reading, Mass.
MILITARY GEODESY AND GEOSPACE SCIENCE, UNIT ONE
Warren G. Heller and A. Richard LeSchack Feb. 1981 191 p refs
(Contract F19628-77-C-0152; AF Proj. 3204)
(AD-A104038; SCIENTIFIC-5; AFGL-TR-81-0028) Avail: NTIS HC A09/MF A01 CSCL 08/5

Unit One introduces the student to Mapping, Charting, and Geodesy. Basic concepts and principles are presented that will be applied during the remainder of the course. The subjects to be covered include: Earth modeling; Coordinate systems; and Techniques of mapping, charting, and geodesy. All of these areas are part of the science of geodesy, which is defined by the three principal subjects with which it is concerned: The size and shape of the earth; The relative location of points on or near the surface of the earth; and The earth's gravity field. The first two areas are referred to as geometric geodesy; the third is physical geodesy. The geometric and physical (or gravitational) aspects of geodesy are closely related to one another, since the

physical surface of the earth does not deviate greatly from an equipotential surface of the gravity field. The material of Unit One is organized into three chapters, each examining geodesy from a different point of view: Geometric geodesy (Chapter Two) -- including material on relevant aspects of cartography and surveying; Physical geodesy (Chapter Three); and Satellite geodesy (Chapter Four) -- emphasizing the unique contributions to geodesy resulting from the use of Earth satellites. GRA

N81-33589# Geological Survey, Denver, Colo. Federal Center.

TOPOGRAPHIC SLOPE CORRECTION FOR ANALYSIS OF THERMAL INFRARED IMAGES Interim Report

Kenneth Watson Mar. 1981 14 p refs

(Contract NASA Order-S-40256-B)

(PB81-211781; USGS-GD-81-002) Avail: NTIS HC A02/MF A01 CSCL 08B

A simple topographic slope correction was developed using a linearized thermal model and assuming slopes less than about twenty degrees. The correction can be used to analyze individual thermal images or composite products such as temperature difference or thermal inertia. Simple curves are provided for latitudes of 30 and 50 degrees. The form is easily adapted for analysis of HCMM images using the Defense Mapping Agency digital terrain data. GRA

N81-33760*# National Aeronautics and Space Administration. Wallops Flight Center, Wallops Island, Va.

GULF OF MEXICO SATELLITE RADAR ALTIMETRY Final Report

C. G. Parra, R. G. Forsythe, and C. L. Parsons Aug. 1981 231 p refs

(NASA-TM-73295) Avail: NTIS HC A11/MF A01 CSCL 08C

The dynamic topography of the sea surface was measured. The radar altimeter measurements yield average ocean topographic data which are mapped. Seasonal deviations from a 3 year mean topography are presented. The altimeters are also instrumented with sample and hold gates which provide information about the shape and amplitude of the return waveform. Parameters including ocean surface wind speed and the significant wave height are determined. One hundred eighty six wind speed and significant wave height histograms are presented. E.A.K.

04
GEOLOGY AND MINERAL RESOURCES

Includes mineral deposits, petroleum deposits, spectral properties of rocks, geological exploration, and lithology.

A81-41908 **Tiwi geothermal project - The Philippines.** R. Aquino (De La Salle University, Manila, Philippines), S. Aquino (Philippine National Oil Co., Manila, Philippines), and A. Alcaraz. In: Geothermal energy projects: Planning and management. New York and Oxford, Pergamon Press, 1980, p. 168-205. 5 refs.

An account is given of the Philippines' Tiwi geothermal field development and related research projects. Among the topics covered are: (1) preliminary research studies throughout the Philippine archipelago, considering such potential sites as direct volcanic exhalations, shallow volcanic sources, deep-seated plutonic sources, and deep faulting in regions of high geothermal gradient; (2) fault systems detected by aerial photographic surveys, such as the plug-dome fault systems, radial fault systems, and arcuate fault systems; (3) performance figures on test drill holes at six different locations; (4) mechanical details of the Tiwi steam-gathering system; (5) the National Power Corporation's organization of responsibilities; and (6) detailed comparisons of energy demand, sources and their costs in the Philippines as seen by the Ten-Year Energy Program for the period 1979-88. O.C.

A81-42276 # **The use of imagery of the earth to study the structure of degassing zones within oil and gas basins (Ispol'zovanie kosmicheskikh snimkov zemli pri izuchenii stroeniia zon degazatsii neftegazonosnykh basseinov).** G. I. Amurskii and M. S. Bondareva (Vsesoiuznyi Nauchno-Issledovatel'skii Institut Prirodnykh Gazov, Moscow, USSR). *Issledovanie Zemli iz Kosmosa,* May-June 1981, p. 5-10. 6 refs. In Russian.

Space imagery is used to identify and trace the local faults and fracture zones of several anticlinal structures in Central Asia. These zones, favorable to the vertical migration of stratified fluids, exhibit an increased permeability, and are therefore subject to degassing and the accumulation of gaseous sulfur. J.F.

A81-42277 # **Concerning the hydrogeological significance of faults on platform regions, as revealed by space imagery (O gidrogeologicheskoi roli razryvnykh narushenii platformennykh oblastei, vyiavliaemykh na kosmicheskikh snimkakh).** M. I. Burleshin and A. V. Sadov (Vsesoiuznyi Nauchno-Issledovatel'skii Institut Gidrogeologii i Inzhenernoi Geologii, Moscow, USSR). *Issledovanie Zemli iz Kosmosa,* May-June 1981, p. 11-17. 9 refs. In Russian.

The characteristics of faults revealed by space imagery are compared with those observed by traditional methods. A hydrogeological interpretation of several faults in the Turanian plate is given, along with the fundamental methods of this interpretation. It is concluded that space imagery may be used to recognize developing faults which would influence the thickness, composition, and plicated structure of the platform rock. Space imagery may also reveal areas of extended rock overlap, influencing rock permeability, and may thus be used to find underground mineral water. Finally, space imagery is important for the accurate definition of hydrogeological region boundaries and the development and revision of hydrogeological maps. J.F.

A81-42278 # **Ring structures of Precambrian shields, based on the interpretation of space imagery (Kol'tsevye struktury Dokembriiskikh shchitov po dannym deshifrirovaniia kosmicheskikh snimkov).** V. M. Moralev (Akademiia Nauk SSSR, Institut Litosfery, Moscow, USSR) and M. Z. Glukhovskii (Proizvodstvennoe Geologicheskoe Ob'edinenie Aerologiia, Moscow, USSR). *Issledovanie Zemli iz Kosmosa,* May-June 1981, p. 18-22. 5 refs. In Russian.

Space imagery interpretations were used to identify two types of ring structures found in Precambrian shields. Large ring structures, reaching a diameter of 900-1200 km, are considered relicts of ancient sedimentary-volcanic basins, corresponding to structures of primary lithospheric cleavage. The second type of ring structures, having a 50-400 km diameter, mainly represent granite-gneiss domes and magmatic diapirs, surrounded by zones of ultrabasite-basic granulite. J.F.

A81-42279 # **Fitoexomorphogenic analysis of geological environment changes in the South Aral Sea, based on aerial and space imagery (Fitoekzomorfogennyi analiz izmenenii geologicheskoi sredy luzhnogo Priaral'ia po aero- i kosmicheskim snimkam).** A. L. Revzon (Vsesoiuznyi Nauchno-Issledovatel'skii Institut Gidrogeologii i Inzhenernoi Geologii, Moscow, USSR). *Issledovanie Zemli iz Kosmosa,* May-June 1981, p. 23-27. 6 refs. In Russian.

A81-42280 # **Space research on seismic regions (Kosmicheskie issledovaniia v seismoaktivnykh regionakh).** B. N. Khovanskii (Gosudarstvennyi Nauchno-Issledovatel'skii i Proizvodstvennyi Tsentr Priroda, USSR). *Issledovanie Zemli iz Kosmosa,* May-June 1981, p. 28-34. 10 refs. In Russian.

Space images have been used to identify fracture zones of high seismic and tectonic activity, where a relatively high percentage of seismic dislocations and earthquake epicenters are located. The combination of space imagery interpretation with the analysis of foreshock data, obtained by geodetic and geophysical methods, is shown to provide an accurate means of long range prediction of earthquake time, location, and intensity. J.F.

A81-42289 # **Geological interpretation in an interactive mode in automated systems of digital image processing (Geologicheskoe deshifrirovanie v dialogovom rezhime v avtomatizirovannykh sistemakh tsifrovoi obrabotki izobrazhenii).** T. P. Belikova, V. E. Gendler, and L. P. Iaroslavskii (Akademiia Nauk SSSR, Institut Problem Peredachi Informatsii; Proizvodstvennoe Geologicheskoe Ob'edinenie Aerologiia, Moscow, USSR). *Issledovanie Zemli iz Kosmosa,* May-June 1981, p. 102-112. 6 refs. In Russian.

The geological interpretation of aerial and space images in automated systems is discussed. Examples are presented using the method of adaptive amplitude transformation for image preparation in interactive mode processing. Brightness characteristics of geological objects and the peculiarities of their interpretation during space photography are discussed. Regions of plicated land masses, formed by Ordovician deposition, are shown at several levels, using the adaptive mode quantization method, and corresponding geological maps are presented with explanations of their symbols. The method of contrast-degree intensification is discussed, whereby the original phototone values are transformed on the basis of a distribution curve of tonal image points. Interactive processing of aerial and space images is shown to dramatically increase the number of objects distinguished, as well as to improve the reliability of the interpretation. J.F.

A81-43215 **Optical and digital analyses of Landsat data depicting hydrogeological features of the Daryacheh-Ye-Namak area, Iran.** M. S. Akhavi (Nova Scotia Land Survey Institute, Lawrencetown, Canada). In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979. Minneapolis, MN, American Water Resources Association, 1981, p. 278-283. 13 refs.

Optical and digital processing techniques were used to detect and map hydrogeological and water resources features at the Daryacheh-Ye-Namak (salt lake) area, north-central Iran. Analyses of optically and digitally enhanced Landsat images, aided by field information, made it possible to depict the changing areal extent and depth of a shallow salt lake occurring in the western section of this internal lacustrine basin. Also, salt surfaces having possible economic value were classified and other pertinent hydrogeologic observations were made using enhanced Landsat data. (Author)

A81-43227 **Correlation of geologic structure inferred from computer enhanced Landsat imagery with underground water supplies in Arizona.** R. Schowengerdt, C. E. Glass (Arizona, University, Tucson, AZ), L. Ethridge (Phillips Petroleum Co., Bartlesville, OK), and E. M. Babcock. In: Satellite hydrology; Proceedings of the Fifth

Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979. Minneapolis, MN, American Water Resources Association, 1981, p. 387-397. 12 refs. U.S. Department of the Interior Grant No. B-066-ARIZ.

Photolineaments of the entire northeast quadrant of Arizona were mapped from standard EROS Data Center false color Landsat composites. Photolineaments were also mapped using computer-enhanced Landsat imagery of two intensive study sites. A third source of geological-structure data was existing large-scale lineament maps derived from aerial photography of the study sites. A spatially distributed parameter obtained from these maps, lineament density, was mathematically correlated with water well survey data (specific capacity, specific conductance, transmissivity, and water temperature) to establish the most useful combination of data for extension of lineament signatures through the entire northeast quadrant. Results from this initial study indicate that Landsat imagery may be used to survey large areas for lineaments, and to cue the hydrogeologist to promising regions, which can then be mapped at aerial photography scales. B.J.

A81-43228 Landsat data for locating shallow glacial aquifers in eastern South Dakota. P. H. Rahn (South Dakota School of Mines and Technology, Rapid City, SD) and D. G. Moore (South Dakota State University, Brookings, SD). In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979. Minneapolis, MN, American Water Resources Association, 1981, p. 398-406. 11 refs. U.S. Geological Survey Contract No. 14-08-0001-13576.

A81-43230 Ground water exploration programs in Africa. L. Zall and O. Russell (Earth Satellite Corp., Washington, DC). In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Fall, SD, June 10-15, 1979. Minneapolis, MN, American Water Resources Association, 1981, p. 416-425. 12 refs.

As part of regional ground water exploration programs in Tanzania, Upper Volta, Benin, and Ghana, ground water exploration guide maps were prepared using digitally processed and photographically enlarged Landsat imagery. Digital processing of Landsat data permits the enhancement of spectral gray levels or subtle tonal variations, such as those caused by lithologic changes, geological structure, or the variation of soil moisture. Such imagery also emphasizes linear features, fractures, or faults that can be missing or difficult to interpret from unprocessed imagery. These guide maps substantially increased the efficiency of operation and decreased the time and expense necessary to complete these programs. B.J.

A81-43232 Applications of aerospace data for detection of submarine springs in Jamaica. F. A. Kohout (U.S. Geological Survey, Woods Hole, MA), D. R. Wiesnet (NOAA, National Earth Satellite Service, Washington, DC), M. Deutsch, J. A. Shanton (U.S. Geological Survey, Reston, VA), and M. C. Kolipinski (U.S. National Park Service, San Francisco, CA). In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979.

Minneapolis, MN, American Water Resources Association, 1981, p. 437-445. 8 refs. Research sponsored by the United Nations.

A project carried out in Jamaica in 1971 by the United Nations Development Programme, the Jamaica Geological Survey, and NASA is discussed. The findings of the underwater SCUBA investigations are correlated with anomalies shown in the aircraft data and with Apollo IX spacecraft photography and TIROS-N satellite imagery. Remote sensing of submarine springs is seen as having the potential of performing at least two useful functions: (1) the discovery of submarine discharge may help to identify geologic or geomorphic structures on the mainland where there would be high probability of drilling successful wells, and (2) periodic observation of the thermal or turbidity anomalies associated with a submarine spring can serve as an outpost system for monitoring hydrologic changes brought about by future expolitation of the aquifer. C.R.

A81-43730 * Use of imaging radar for geology and archeology. M. Daily (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA). In: Rainbow 80; Fall Technical Meeting, Niagara Falls, NY, October 7-10, 1980, ASP Technical Papers. Falls Church, VA, American Society of Photogrammetry, 1981, p. DA-1-B-1 to DA-1-B-13.

Imaging radar is shown to be a useful sensor for geological analysis as a standal one sensor in clouded regions or as a complementary data source with visible NIR systems. Radar image tone is a function of the radar system parameters (imaging geometry, frequency, polarization) and a function of the target (local slope, electrical properties, and surface roughness). Substantial topographic texture enhancement can be achieved for large scale features by using specular returns associated with steep-incidence radars or shadows associated with grazing-incidence systems. Texture enhancement also allows radar to image lineaments and archeological features, such as canals and causeways. Future multispectral radars may achieve better discrimination of subresolution structures. Seasat radar images of several geographic locations are provided. J.F.

A81-44061 # The possibility of using an aerial thermal survey for studying the structure of the salt bed in the Gulf of Kara-Bogaz-Gol (O vozmozhnosti primeneniia teplovoi aeros'emki dlia izucheniia stroeniia solianogo plasta Zaliva Kara-Bogaz-Gol). V. I. Gornyi (Vsesoiuznoe Aerogeologicheskoe Nauchno-Proizvodstvennoe Ob'edinenie Aerogeologiia, Leningrad, USSR). *Akademiia Nauk SSSR, Doklady,* vol. 259, no. 2, 1981, p. 321-323. 5 refs. In Russian.

A81-45430 * A radar image time series. F. Leberl, H. Fuchs (Graz, Technische Universität, Graz, Austria), and J. P. Ford (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA). *International Journal of Remote Sensing,* vol. 2, Apr.-June 1981, p. 155-183. 13 refs. Contract No. NAS7-100.

A set of ten side-looking radar images of a mining area in Arizona that were aquired over a period of 14 yr are studied to demonstrate the photogrammetric differential-rectification technique applied to radar images and to examine changes that occurred in the area over time. Five of the images are rectified by using ground control points and a digital height model taken from a map. Residual coordinate errors in ground control are reduced from several hundred meters in all cases to + or - 19 to 70 m. The contents of the radar images are compared with a Landsat image and with aerial photographs. Effects of radar system parameters on radar images are briefly reviewed. F.G.M.

A81-46039 Lineament mapping in northern Sweden from Landsat images using orthogonal image transforms. L. C. Andersson and H. Hauska (Lulea, Hogskola, Lulea, Sweden). In: Machine processing of remotely sensed data and soil information systems and remote sensing and soil survey; Proceedings of the Sixth Annual Symposium, West Lafayette, IN, June 3-6, 1980.
New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 147-157. Styrelsen for Teknisk Utveckling Contracts No. 76-6669; No. 77-6345.

A81-46194 Geomorphic mapping from Landsat-3 Return Beam Vidicon /RBV/ imagery. G. R. Cochrane and G. H. Browne (Auckland, University, Auckland, New Zealand). *Photogrammetric Engineering and Remote Sensing,* vol. 47, Aug. 1981, p. 1205-1213. 17 refs.

Landsat-3 Return Beam Vidicon (RBV) imagery of eastern North Island of New Zealand is useful for regional geomorphic mapping. Three broad tectono-physiographic regions - Western Taupo volcanic plateau zone, Central blockfaulted Mesozoic greywacke zone, and Eastern Inland Hawke Bay zone of dissected Tertiary hill country - are recognized and their features discussed. Some previously unmapped lineaments are noted. Ten geomorphic categories - coastal dunes, raised marine terraces, alluvial terraces, volcanic cones, dip slopes, large landslides, undissected plateau, dissected plateau, undulating hill country, and steep hill country - have been successfully mapped from the RBV data. The principal advantages of RBV images for geomorphic mapping are their improved geometric accuracy and their relatively high spatial resolution (40 m). Limitations in differentiating land-water interfaces are present. Landsat RBV imagery can be used to supplement future studies in the earth sciences, especially in remote or poorly mapped areas. (Author)

A81-47353 Ore-controlling space geological objects and their assessment techniques applied to mineral prediction. A. L. Stavtsev (Ministerstvo Geologii SSSR, Ob'edinenie Aerogelogiia, Moscow, USSR). *International Astronautical Federation, International Astronautical Congress, 32nd, Rome, Italy, Sept. 6-12, 1981, Paper 81-107.* 4 p.

The importance of rupture dislocations is assessed, and it is noted that faults and fault zones are commonly well exhibited on space images. The combined analysis of fault identification charts and maps of the distribution of known mineral deposits makes it possible to assess the role of rupture dislocations in the spatial distribution of minerals and to delineate, through analogy, promising areas for mineral extraction. Attention is also given to the analysis of the ore-controlling importance of ring structures and to the combined application of identified space images and geological and geophysical data to a computerized mineral prediction. It is concluded that the application of space images to mineral exploration provides geologists with ample opportunity for studying the spatial distribution of metallic and nonmetallic ores and predicting their potential occurrences. C.R.

A81-48683 # The informational estimation of the effectiveness of using satellite imagery in hydrogeological research (Opyt informatsionnoi otsenki effektivnosti primeneniia kosmicheskikh snimkov v gidrogeologicheskikh issledovaniiakh). M. I. Burleshin and V. N. Koloskova (Vsesoiuznyi Nauchno-Issledovatel'skii Institut Gidrogeologii i Inzhenernoi Geologii, Moscow, USSR). *Issledovanie Zemli iz Kosmosa,* July-Aug. 1981, p. 27-31. 6 refs. In Russian.

An informational approach is used to estimate the effectiveness of using satellite imagery in the hydrogeological mapping of the Ustiurt Plateau. Satellite imagery and intermediate and final schemes of the hydrogeological interpretation are represented as data channels. Based on information theory, a quantitative estimation and a comparison of the contents of hydrogeological maps, compiled by terrestrial mapping and space imagery interpretation, are made. J.F.

A81-48684 # The use of satellite imagery for studying the structural features of the Caspian oil and gas region (Primenenie kosmicheskikh materialov dlia izucheniia strukturnykh osobennostei pri-Kaspiiskoi neftegazonosnoi provintsii). L. F. Volchegurskii and V. G. Pronin (Vsesoiuznoe Aerogeologicheskoe Nauchno-Proizvodstvennoe Ob'edinenie Aerogeologiia, Moscow, USSR). *Issledovanie Zemli iz Kosmosa,* July-Aug. 1981, p. 32-38. 8 refs. In Russian.

Based on a study of satellite imagery, the boundaries of the Caspian oil and gas region are defined, and the linear structures, interpreted as faults or zones of faults, are distinguished. Ring structures, corresponding to the structures of the different horizons of the sedimentary cover and bedplate, are discussed. Based on the data obtained by satellite imagery, a detailed scheme of the oil and gas geological regionalization is presented. Such a study is then used to define the individual oil and gas zones within the range of the Caspian region, to trace the extended faults which play a significant role in forming these oil and gas zones, to select regions of seismic research, and to reinterpret the structural maps. J.F.

A81-48685 # The interrelation of linear and isometric objects on satellite imagery and the oil and gas structures of the Buzuluk Basin (O vzaimosviazi lineinykh i izometrichnykh ob'ektov na kosmicheskikh snimkakh i neftegazonosnykh struktur Buzulukskoi vpadiny). D. M. Trofimov and B. I. Dmitrieva (Moskovskii Gosudarstvennyi Universitet, Moscow, USSR). *Issledovanie Zemli iz Kosmosa,* July-Aug. 1981, p. 39-44. 5 refs. In Russian.

A81-48690 # Complex processing of satellite images and the geological interpretation (Kompleksnaia obrabotka kosmicheskikh snimkov i geologicheskaia interpretatsiia). V. S. Iudin (Akademiia Nauk SSSR, Institut Geologii i Geofiziki, Novosibirsk, USSR). *Issledovanie Zemli iz Kosmosa,* July-Aug. 1981, p. 70-75. 20 refs. In Russian.

A correlation between the appearance of natural formations in geological and geophysical measurements and their representation on satellite images is established, based on the data of standard survey regions. The contents of the images, subjected to computer processing, can provide much information on geological processes. A comprehensive analysis using the indicated correlated dependences is used to produce a preliminary classification of tectonic structures and can reveal several phenomena of deep-seated processes in the regions. The obtained results may be used to find valuable mineral deposits. J.F.

A81-48691 # Interactive system for the regional prognosis of raw mineral resources, based on ground-based and satellite imagery data (Dialogovaia sistema regional'nogo prognozirovaniia mineral'no-syr'evykh resursov po dannym nazemnykh i kosmicheskikh s'emok). B. A. Chumachenko, V. V. Marchenko, E. P. Vlasov, E. A. Nemirovskii, and V. A. Iakovlev (Mezhdunarodnyi Nauchno-Issledovatel'skii Institut Problem Upravleniia, Moscow, USSR). *Issledovanie Zemli iz Kosmosa,* July-Aug. 1981, p. 76-82. 5 refs. In Russian.

The interactive system 'Region' is used for forecasting potential areas of raw mineral resources from ground and space survey data. Mathematical models which forecast and estimate the prospective ore content and heuristic models concerning the regularity of ore location are stored in one data bank. Data of aerospace, ground-based, geological, geophysical, and geochemical images as well as their descriptions are kept in a second regional bank. Data from both banks are processed by a logical-statistical program. An algorithm for distinguishing images with standard patterns is performed, and a program for the classification of nonstandard patterns is carried out, based on a taxonomy method. Algorithmic programs of simulated modeling are then performed, producing a variety of prognosis solutions. J.F.

A81-49767 # Experimental use of real time SAR imagery in support of oil exploration in the Beaufort Sea. J. B. Mercer (Dome Petroleum, Ltd., Calgary, Alberta, Canada), R. T. Lowry, and S. K. Leving (Intera Environmental Consultants, Ltd., Ottawa, Canada). In: Canadian Symposium on Remote Sensing, 6th, Halifax, Canada, May 21-23, 1980, Proceedings. Ottawa, Canadian Aeronautics and Space Institute, 1981, p. 143-152. 8 refs. Research supported by Dome Petroleum, Ltd.

SAR imagery, generated in real-time, has been used for the first time to support an Arctic marine operation. During the latter portion of Dome Petroleum's late season drilling program (November 1979) in the Beaufort Sea, the SAR-580 flew daily missions to provide near real-time 'snap shots' of the ice conditions in the vicinity of the operations. The aim of the program was to assist both the icebreaker support of the drillship and the subsequent navigation back to harbor. To provide the context for this SAR application, a review of Beaufort Sea ice conditions is presented along with a brief discussion of the problems and techniques of the interpretation of the SAR imagery. The downlink and operational performance of the SAR are described along with an outline of an improved system. B.J.

A81-49769 # Applicability of airborne SAR data to geological mapping. S. Pala, R. Mussakonski, and E. Wedler (Ministry of Natural Resources, Ontario Center for Remote Sensing, Toronto, Canada). In: Canadian Symposium on Remote Sensing, 6th, Halifax, Canada, May 21-23, 1980, Proceedings. Ottawa, Canadian Aeronautics and Space Institute, 1981, p. 169-177.

Airborne SAR data, obtained over the Canadian Shield in the vicinity of Sudbury and Haliburton, is analyzed to establish its usefulness and its limitations as a geological mapping tool. Various inherent geological features in volcanic, igneous and metamorphic rock groups are examined on the radar imagery in an effort to determine what can and cannot be detected. An attempt has been made to recognize all the known geological features on the SAR imagery. The characteristics of radar data from X and L bands, both parallel and cross-polarized, were individually studied for the purpose of identifying the usefulness of each band. Successful use of SAR imagery as a geological mapping tool will depend upon the attributes and limitations of the data to distinguish those surface elements necessary for mapping. The techniques used and the results obtained are described. The radar and terrain characteristics which were useful, or which created limitations, are examined and discussed. B.J.

A81-49802 # Geological and terrain analysis of the Annapolis County region of Nova Scotia - An application of digital Landsat, radar and colour infrared data. V. H. Singhroy (J. D. Mollard and Associates, Ltd., Regina, Saskatchewan, Canada), W. D. Bruce (Canada Centre for Remote Sensing, Ottawa, Canada), and G. R.

Stevens (Acadia University, Wolfville, Nova Scotia, Canada). In: Canadian Symposium on Remote Sensing, 6th, Halifax, Canada, May 21-23, 1980, Proceedings. Ottawa, Canadian Aeronautics and Space Institute, 1981, p. 501-511. 15 refs.

It is pointed out that in areas where detailed geological information is lacking and rock outcrops are covered by thick glacial drift, a comprehensive exploration program must involve both field geologists and remote sensing scientists. The contribution of remotely sensed data to the understanding of the structural and glacial geology of the Annapolis County region where exploration programs are active is assessed. Optical and digital processing of Landsat data, together with visual interpretation of radar and color imagery, are found to be valuable in delineating significant geological features. It is noted that multidate digital Landsat data have contributed to the delineation of glacial lineaments, major faults, and 'convectional cells'. Also discussed is the contribution of color infrared data in the verification of digital Landsat themes. C.R.

A81-49809 # **Detection of changes in a coal surface mining area by ratioing multidate Landsat digital data.** D. O. Ohlen (Technicolor Graphic Services, Inc., Sioux Falls, SD). In: Canadian Symposium on Remote Sensing, 6th, Halifax, Canada, May 21-23, 1980, Proceedings. Ottawa, Canadian Aeronautics and Space Institute, 1981, p. 581, 582.

Two procedures are compared for determining change in a coal surface mining area in southern Montana using ratioed multidate Landsat data. Subscenes of Landsat band 5 multispectral scanner data acquired in July 1976 and June 1977 are selected. Each subscene is geometrically corrected to a U.S. Geological Survey 7.5 minute topographic map based and resampled using a 100-meter square pixel. The first procedure used in determining the ranges of ratioed data associated with land cover change involves a comparison of a line printer output of pixel values of the ratioed data with the actual changes that occurred in land cover. The second procedure involves interactive manipulation of the minimum and maximum brightness values in a histogram of the ratioed data to determine which pixels become brighter or darker during the test period. Although the two procedures produce similar results, neither procedure gives results adequate for identifying changes produced by surface mining. C.R.

N81-29143* National Aeronautics and Space Administration, Washington, D. C.
NASA SELECTS SCIENTIFIC INVESTIGATIONS FOR EARTH DYNAMICS STUDIES
21 Aug. 1981 9 p
(NASA-News-Release-81-129; P81-10131) Avail: NASA Scientific and Technical Information Facility, P.O. Box 8757, B.W.I. Airport, Md. 21240 CSCL 22A

Forty two domestic investigators affiliated with U.S. universities, governmental agencies, or private concerns and 14 investigators from France, West Germany, the Netherlands, Switzerland, Spain, Sweden, Australia, New Zealand, Venezuela, and Canada were selected to use precise geodetic data obtained by laser ranging and very long base interferometry in a study of the Earth's tectonic plate movement, crustal deformation, and rotational dynamics. The studies to be made and the principal investigators for each are listed. A.R.H.

N81-30502# Rice Univ., Houston, Tex. Dept. of Geology.
METHODS DEVELOPMENT AND APPLICATIONS EVALUATIONS OF NURE AERIAL RECONNAISSANCE SURVEY DATA FOR URANIUM RESOURCE EVALUATION: BEEVILLE/BAY CITY AND CRYSTAL CITY QUADRANGLES, TEXAS Final Report
John A. S. Adams, Sam F. Harrill, and J. E. Oddo Apr. 1981 115 p refs Prepared for Bendix Field Engineering Corp., Grand Junction, Colo.
(Contracts DE-AC08-76NV-01183; DE-AC13-76GJ-01664) (GJBX-69(81)) Avail: NTIS HC A06/MF A01

The NURE open-file reports on the aerial gamma spectrometric, hydrologic, and stream-sediment surveys of some 50,000 square kilometers of land area in south Texas were studied in regard to their utility in identifying regions of high or higher favorability for uranium deposits. Substantial agreement was found between the NURE aerial data and the ground and helicopter data as regards the general radioelement distributions in the stratigraphic units studied. The vehicle-mounted gamma-ray spectrometer used systematically gave some 30 percent higher thorium concentration estimates when compared with those from the NURE aerial data. The NURE aerial data are adequate in number to characterize the major stratigraphic units, but they may not be quantitative enough for detailed comparisons from one quadrangle to another, and the optimum sampling area for each formation is not known. DOE

N81-31594 Stanford Univ., Calif.
ATMOSPHERIC CORRECTION TO LANDSAT DATA FOR LIMONITE DISCRIMINATION Ph.D. Thesis
William Stephen Kowalik 1981 400 p
Avail: Univ. Microfilms Order No. 8115805

A simple equation describing the radiance measured by the LANDSAT satellites over Lambertian surfaces was used to model the effects of the additive path-radiance and skylight irradiance terms when band ratios are used. The model results show that if the path-radiance and skylight are not corrected, than ratio values (longer wavelength in numerator) increase significantly when proceeding from poorly-illuminated to well-illuminated topographic slopes of the same surface material. After a modeled pathradiance correction, this tendency is reduced, for example, in the 5/4 ratio by a factor of 4X across moderately steep topography. LANDSAT data for 183 test sites (pixel size) in the Yerington District, Nevada were studied from each of 6 images to test the conclusions from the modeling in a mineral exploration framework. The 183 test sites represent three major rock types: (1) limonitically-altered Jurassic quartz monzonite: (2) nonlimonitically altered Jurassic granodiorite rocks; and (3) Teritary volcanic rocks. Field and lab work on each site have characterized the rock type, intensity of iron oxide mineral development, surface topographic orientation, percentage vegetation cover, and vegetation species present. Dissert. Abstr.

N81-32575*# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
VISUAL ENHANCEMENT OF IMAGES OF NATURAL RESOURCES: APPLICATIONS IN GEOLOGY [REALCE VISUAL DE IMAGENS DE RECURSOS NATURAIS: APLICACOES EM GEOLOGIA]
Nelson deJesusParada, Principal Investigator, Gilberto Neto, Evandro O. Araujo, Nelson D. A. Mascarenhas, and Ricardo C. M. deSouza Dec. 1980 55 p refs In PORTUGUESE; ENGLISH summary Presented at the 32nd Reuniao Anual da SBPC, Rio de Janeiro, 6-12 Jul. 1980 Sponsored by NASA ERTS
(E81-10181; NASA-CR-164693; INPE-1952-RPE/267) Avail: NTIS HC A04/MF A01 CSCL 08G

The principal components technique for use in multispectral scanner LANDSAT data processing results in optimum dimensionality reduction. A powerful tool for MSS IMAGE enhancement, the method provides a maximum impression of terrain ruggedness; this fact makes the technique well suited for geological analysis. A.R.H.

N81-32587# Army Engineer Topographic Labs., Fort Belvoir, Va.
IDENTIFYING IGNEOUS ROCKS IN AN ARID ENVIRONMENT ON AERIAL PHOTOGRAPHY BY PHOTO TONE AND PHOTO TEXTURE
Judy Ehlen 15 May 1981 26 p refs
(AD-A102809; ETL-R019) Avail: NTIS HC A03/MF A01 CSCL 14/5

Work concerning identifying igneous rock types on aerial photography began in the late 1940's and early 1950's (Belcher, and others, 1951; Frost, and others, 1953). Even now, the only igneous rocks thought by many to be identifiable on aerial photography are granite, basalt, and some pyroclastic rocks (Military Geology, 1956; von Bandat, 1962; Way, 1973; and Lillesand and Kiefer, 1979). Recent work has shown, however, that other specific igneous lithologies, such as andesite and monzonite, can be identified successfully by air photo analysis (Ehlen, 1981). The purpose of this study was to determine how, and to what level of classification, igneous rocks can be identified by air photo interpretation procedures. Thus, the specific objectives were: (1) to further evaluate established igneous rock identification criteria for arid and semiarid environments, (2) to discover new photo pattern indicators for igneous rocks in these climates, and (3) to develop a classification for igneous rocks based on their photo patterns, similar to a petrologic classification. GRA

N81-32592# High Life Helicopters, Inc., Puyallup, Wash.
AIRBORNE GAMMA-RAY SPECTROMETER AND MAGNETOMETER SURVEY
1980 78 p
(Contract DE-AC13-79GJ-01692)
(DE81-027157; GJBX-211(81)) Avail: NTIS HC A05/MF $11.00

An airborne combined radiometric and magnetic survey was performed over the area covered by the Toronto, Buffalo, Kingston, Rochester, and Elmira, 1:250,000 National Topographic Map Series (NTMS), quadrangle maps. The survey was part of DOE's National Uranium Resource Evaluation (NURE) program. Data were collected by a helicopter equipped with a gamma-ray spectrometer with a large crystal volume, and with a high sensitivity proton precession magnetometer. The radiometric system was calibrated at the Walker Field Calibration pads and the Lake Mead Dynamic Test Range. Data quality was ensured during the survey by daily test flights and equipment checks. Radiometric data were corrected for live time, aircraft and equipment background, cosmic background, atmospheric radon, Compton scatter, and altitude dependence. The corrected data were statistically evaluated, plotted, and contoured to produce anomaly maps based on the radiometric response of individual geological units. The anomalies were interpreted and an interpretation map produced. DOE

N81-33548*# College of William and Mary, Williamsburg, Va. Dept. of Geology.
MINERALOGICAL, OPTICAL, AND GEOCHEMICAL PROPERTIES OF JOHN H. KERR RESERVOIR SEDIMENT SAMPLES FOR AgRISTARS POLLUTION RESEARCH
Karen L. Bice and Stephen C. Clement, Principal Investigators
Aug. 1981 18 p refs Sponsored by NASA, USDA, Dept. of Commerce, Dept. of Interior, and Agency for International Development ERTS
(Contract NAS1-16042; Proj. AgRISTARS)
(E81-10155; NASA-CR-165762) Avail: NTIS HC A02/MF A01 CSCL 08F

X-ray diffraction and spectroscopy were used to investigate and compare the mineralogical and chemical properties of two Kerr Reservoirs sediment samples. The index of refractions of the kaolinite present in each sample was determined also. The sediments are composed primarily of illite, kaolinite, quartz, and minor amounts of chlorite. The most abundant elements in the sediment samples are silicon, aluminum, and iron. The kaolinite of sample K-10-80 has a higher index of refraction than that of sample K-3-81. Author

N81-33584# High Life Helicopters, Inc., Puyallup, Wash.
AIRBORNE GAMMA-RAY SPECTROMETER AND MAGNETOMETER SURVEY. CANYON CITY QUADRANGLE (OREGON), VOLUME 2 Final Report
1981 212 p refs Prepared jointly with QEB, Inc.
(Contract DE-AC13-79GJ-01692)
(DE81-028682; GJBX-240-81-V2-(Canyon-City)) Avail: NTIS HC A10/MF A01

Fourteen uranium anomalies are listed and are shown on the uranium anomaly interpretation map. Potassium (%K), equivalent uranium (ppM eU), equivalent thorium (eT), eU/eT, eU/K, eT/K, and magnetic pseudo contour maps are presented. Stacked profiles showing geologic strip maps along each flight-line, together with sensor data, and ancillary data are included. Geologic unit designations are given for each of the 14 uranium anomalies. All maps and profiles were prepared on a scale of 1:250,000, but have been reduced to 1:500,000 for presentation. DOE

N81-33585# High Life Helicopters, Inc., Puyallup, Wash.
AIRBORNE GAMMA-RAY SPECTROMETER AND MAGNETOMETER SURVEY, SALEM QUADRANGLE (OREGON), VOLUME 2 Final Report
1981 126 p refs Prepared in cooperation with QEB, Inc., Lakewood, Colo.
(Contract DE-AC13-79GJ-01692)
(DE81-028681; GJBX-240-81-Vol-2-(Salem)) Avail: NTIS HC A07/MF A01

Five uranium anomalies which meet the minimum statistical requirements are tabulated and are shown on the uranium anomaly interpretation map. Potassium (%K), equivalent uranium (ppM eU), equivalent thorium (eT), eU/eT, eU/K, eT/K, and magnetic pseudo-contour maps are presented. Stacked profiles showing geologic strip maps along each flight-line, together with sensor data, and ancillary data are included. All maps and profiles were prepared on a scale of 1:250,000, but were reduced to 1:500,000 for presentation. Each of the anomalies occurs over the Eocene Tyee and Burpee formation (Teme), a rhythmically banded, feldspathic and micaceous, massive bedded sandstone, and siltstone. Anomalies 1, 2, 3, and 4 are in the northwest corner of the map. Anomalies 2 and 3 are near faults, so may be due to radon leaking from the faults. Anomaly No. 5 is in the southwest corner of the map. DOE

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OCEANOGRAPHY AND MARINE RESOURCES

Includes sea-surface temperature, ocean bottom surveying imagery, drift rates, sea ice and icebergs, sea state, fish location.

A81-41350 **Method for estimation of ocean current velocity from satellite images.** E. Mollo-Christensen (MIT, Cambridge, MA), P. Cornillon, and A. D. S. Mascarenhas, Jr. *Science*, vol. 212, May 8, 1981, p. 661, 662. 6 refs. Contracts No. N00014-79-C-0413; No. N00014-75-C-0291.

Barotropic instability waves on a shear interface propagate at the average speed of the water on the two sides. Assuming the instability to be excited by tidal oscillations, the phase speed is the wavelength divided by the tidal period. If the water is at rest on one side of the shear layer the current speed on the other side can be calculated. This method, applied to the Gulf Stream beyond Cape Hatteras as seen in satellite images, gives estimates of current speed in general agreement with in situ observations. (Author)

A81-41490 # **Evaluation of the effect of sea-ice roughness on the microwave emission of the ice (Otsenka vliianiia sherokhovatosti morskogo l'da na ego radioteplovoe izluchenie).** P. A. Nikitin. In: Some results on the investigation of earth resources by aerial and polygon methods. Leningrad, Gidrometeoizdat, 1980, p. 93-97. In Russian.

Formulas of geometric optics are used to calculate the effect of the surface roughness of sea ice on its microwave emission. The ice was modeled as a homogeneous isothermal medium with a normal distribution of elementary-area inclinations. Available data on Arctic sea ice were used as input parameters. It is found that, in the case of horizontal polarization, emissivity increments due to roughness can exceed by 30% the amplitudes of possible variations of the microwave emissivity of Arctic water surfaces. B.J.

A81-41755 **Satellite aided coastal zone monitoring and vessel traffic system.** J. L. Baker (Baker Development Corp., Sherwood Forest, MD). *(Institute of Navigation, Annual Meeting, 36th, U.S. Naval Postgraduate School, Monterey, CA, June 23-26, 1980.) Navigation*, vol. 27, Winter 1980-1981, p. 290-304.

A technique used to continuously monitor the location of cooperating vessels within the 200-nautical-mile U.S. coastal zone is discussed. Using the ATS-3 satellite, the LORAN-C navigational system is based on the 'roll call' technique, and is similar to shore-based ship traffic advisory systems using radar. A description and demonstration of the operational system are given, including the onboard, satellite, communications, display, and control systems. Capabilities of the system include search and rescue, coastal zone management, avoidance of collisions and grounding, ships entering territorial waters, military, and research and exploration. In conclusion, the system is shown to be operational in any weather, relatively inexpensive, able to communicate with all commercial or government satellites, andd possessing unlimited range. D.L.G.

A81-41974 * **Seasat data applications by commercial users.** D. R. Montgomery (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA). *Marine Geodesy*, vol. 4, no. 4, 1980, p. 387-416. 9 refs. Contract No. NAS7-100.

The Seasat Program was initiated as a proof-of-concept mission to evaluate the effectiveness of a study of remotely sensed oceanographic phenomena from a satellite platform. From its inception the Seasat Program has been user-oriented. The user comprised three major segments of the ocean community, including academic users, users within various government agencies, and commercial users. Commercial users represent a broad spectrum of commercial marine industries. The commercial users proposed to NASA to carry out a pilot demonstration to assess the utility of Seasat data in the private sector. The commercial users' program is considered along with case studies that utilize Seasat data, and aspects of real-time system operation. Attention is given to the potential value of an employment of synthetic aperture radar, the altimeter, the scatterometer, and the scanning multichannel microwave radiometer. G.R.

A81-41996 * **Oceanic Satellite Data Distribution System.** D. R. Montgomery (NASA, Washington, DC). *Marine Technology Society Journal*, vol. 14, no. 6, 1980, p. 28-30.

The Satellite Data Distribution System (SDDS) serves to process satellite-derived ocean observations, generate ocean analysis and forecast products, and distribute the products to a limited set of commercial users. The SDDS functions in series with the U.S. Navy Fleet Numerical Oceanography Center (FNOC) to provide products on a near-real-time basis to commercial marine industries. Conventional meteorological and oceanographic observations provided to FNOC serve as the input set to the numerical analysis and forecast models. Large main-frame computers are used to analyze and forecast products on a routine, operational basis (at 6-hour and 12-hour synoptic times). The products, reformatted to meet commercial users needs, are transferred to a NASA-owned computer for storage and distribution. Access to the information is possible either by a commercial dial-up packet-switching network or by a direct computer-computer connection. J.F.

A81-41997 * **Future plans for NASA's Oceanic Processes Program.** W. S. Wilson (NASA, Office of Space and Terrestrial Applications, Oceanic Processes Branch, Washington, DC). *Marine Technology Society Journal*, vol. 14, no. 6, 1981, p. 26, 27.

NASA's Oceanic Processes Program has the objectives to develop a scientific basis for viewing the oceans from space and to demonstrate the utility of such an undertaking. There are currently four flight projects concerning the oceanic area. These projects are related to the National Oceanic Satellite System (NOSS), the Dynamic Ocean Topography Experiment (TOPEX), the Gravity Satellite (GRAVSAT), and a Synthetic Aperture Radar (SAR) mission. NOSS is being planned as a limited operational demonstration of viewing the oceans from space. It is to provide a capability to observe surface winds, waves, temperature, color, ice cover, and currents. It is scheduled for launch in 1986. TOPEX and GRAVSAT are being planned as research missions and are both scheduled for launch about 1986. The SAR mission is being planned to provide a spaceborne capability to observe the surface of the land and the oceans. G.R.

A81-42026 **Imaging ocean waves by synthetic aperture radars with long integration times.** C. L. Rufenach (NOAA, Wave Propagation Laboratory, Boulder, CO) and W. R. Alpers (Hamburg, Universität; Max-Planck-Institut für Meteorologie, Hamburg, West Germany). *IEEE Transactions on Antennas and Propagation*, vol. AP-29, May 1981, p. 422-428. 25 refs. NOAA-supported research; Grant No. NATO-SRG-10.

The effect of long integration time on synthetic aperture radar imagery of moving ocean waves is examined in view of the fact that Seasat images have resulted in a coherent integration time of 2.5 s (one-look processing) when processed to the full resolution of 6.25 m. First, the orbital motion on image formation is investigated, with results based on a Bessel series expansion of the phase term. Image patterns are evaluated numerically for a monochromatic wave traveling in the azimuthal direction. Then, the effect of the coherence time of the ocean wave field on the azimuthal resolution is examined. It is concluded that the scene coherence time for ocean wave imagery is usually several seconds, and therefore, for most radars and sea states, it is not the limiting factor in the imaging process; the orbital acceleration associated with long waves is usually more important for the degradation in the azimuthal resolution. K.S.

A81-42066 # **A comparison of Seasat 1 altimeter measurements of wave height with measurements made by a pitch-roll buoy.** D. J. Webb (Institute of Oceanographic Sciences, Wormley, Surrey, England). *Journal of Geophysical Research*, vol. 86, July 20, 1981, p. 6394-6398. 13 refs.

Measurements of significant wave-height, made by pitch-roll buoy on eight occasions taken during the Joint Air-Sea Interaction Experiment, were compared with the Seasat 1 radar altimeter measurements. Wave heights were estimated from the leading edge of the smoothed pulse, and the significant wave height was found to be

between 0.8 and 2.3 m. The mean value for the ratio of the radar altimeter measurements to the buoy measurements was 0.96 + or - 0.04, and the standard deviation of each value was 0.10. The variance was found to be consistent with the spatial variations in the wave field and other known sources of error, on six occasions, whereas, on two occasions, the variance was found to be larger, thus indicating that some other factor may be involved. K.S.

A81-42067 * # Microwave radiometer measurement of tidally induced salinity changes off the Georgia coast. B. M. Kendall (NASA, Langley Research Center, Hampton, VA), and J. O. Blanton (Skidaway Institute of Oceanography, Savannah, GA). *Journal of Geophysical Research,* vol. 86, July 20, 1981, p. 6435-6441. 7 refs. NASA-supported research; Contract No. DE-AS09-80EV-1033.

A quasi-synoptic survey of tidally induced salinity changes off the Georgia coast was performed by using a L band microwave radiomater onboard a NASA aircraft. Salinity maps were obtained for ebb and flood conditions in order to define the salinity distributions near rivers and sounds and major changes that occur from ebb flow to flood flow. The Savannah River plume dominated the salinity regime and extended out from the Savannah River mouth about 12 km during ebb tidal conditions. The plume merged into a band of low salinity water extending along the Georgia-South Carolina coast which was produced by the many river sources of freshwater entering the coastal waters. The changes in salinity observed offshore of the river plume area were consistent with estimates of the changes that would occur over a typical tidal excursion perpendicular to the observed gradient. (Author)

A81-42102 # Satellite scatterometer. A. Kühnle. *Dornier-Post* (English Edition), no. 2, 1981, p. 9, 10.

Research in the use of microwave instruments to measure ocean wind-vector fields and wave spectra is briefly discussed. The principle of determining wind vectors is examined, and a mathematical model of radar backscattering by capillary waves on the ocean surface is described. The existence of a satellite scatterometer developed in Western Europe is noted. F.G.M.

A81-42131 Sea ice detection using enhanced infrared satellite data. G. L. Hufford (NOAA, Satellite Field Services Station, Anchorage, AK). *Mariners Weather Log,* vol. 25, Jan.-Feb. 1981, p. 1-6.

A81-42215 * Remote sensing of oceanic phytoplankton - Present capabilities and future goals. W. E. Esaias (NASA, Langley Research Center, Hampton, VA). In: Primary productivity in the sea. New York, Plenum Publishing Corp., 1980, p. 321-337. 29 refs.

A description is given of current work in the development of sensors, and their integration into increasingly powerful systems, for oceanic phytoplankton abundance estimation. Among the problems relevant to such work are phytoplankton ecology, the spatial and temporal domains, available sensor platforms, and sensor combinations. Among the platforms considered are satellites, aircraft, tethered balloons, helicopters, ships, and the Space Shuttle. Sensors discussed include microwave radiometers, laser fluorosensors, microwave scatterometers, multispectral scanners, Coastal Ocean Dynamics Radar (CODAR), and linear array detectors. Consideration is also given to the prospects for such future sensor systems as the National Oceanic Satellite System (NOSS) and the Airborne Integrated Mapping System (AIMS). O.C.

A81-42228 Application of remote sensing to monitoring and studying dispersion in ocean dumping. R. W. Johnson and C. W. Ohlhorst (NASA, Langley Research Center, Hampton, VA). In: Ocean dumping of industrial wastes. New York, Plenum Publishing Corp., 1981, p. 175-191. 19 refs.

Remotely sensed wide area synoptic data provides information on ocean dumping that is not readily available by other means. A qualitative approach has been used to map features, such as river plumes. Results of quantitative analyses have been used to develop maps showing quantitative distributions of one or more water quality parameters, such as suspended solids or chlorophyll a. Joint NASA/NOAA experiments have been conducted at designated dump areas in the U.S. coastal zones to determine the applicability of aircraft remote sensing systems to map plumes resulting from ocean dumping of sewage sludge and industrial wastes. A second objective is related to the evaluation of previously developed quantitative analysis techniques for studying dispersion of materials in these plumes. It was found that plumes resulting from dumping of four waste materials have distinctive spectral characteristics. The development of a technology for use in a routine monitoring system, based on remote sensing techniques, is discussed. G.R.

A81-42553 # Investigation of illumination in the image plane of the receiving optical system for the aerial or spaceborne photography of the world ocean (Issledovanie osveshchennosti v ploskosti izobrazheniia priemnoi opticheskoi sistemy pri aerokosmicheskoi s'emke akvatorii mirovogo okeana). V. V. Polovinko (Moskovskii Institut Inzhenerov Geodezii, Aerofotos'emki i Kartografii, Moscow, USSR). *Geodeziia i Aerofotos'emka,* vol. 1, 1981, p. 73-82. 10 refs. In Russian.

The illumination in the image plane of the receiving optical system for the aerial or spaceborne photography of the ocean is studied as a function of the optical properties of the cloudless atmosphere, the ocean, and the receiving system. Equations are obtained for the brightness of ocean areas whose emission is detected by the receiving system in the visible and IR ranges. Equations describing the aerial and spaceborne photography are presented. B.J.

A81-42622 * Wave direction measured by four different systems. M. G. Mattie (U.S. Army, Coastal Engineering Research Center, Ft. Belvoir, VA), S. V. Hsiao (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA), and D. D. Evans (Hughes Aircraft Co., Radar Systems Group, El Segundo, CA). *IEEE Journal of Oceanic Engineering,* vol. OE-6, July 1981, p. 87-93. 13 refs. Contract No. NAS7-100.

A March 1977 wave direction measurement experiment is reported in which four systems were used to provide offshore wave-direction information: (1) synthetic aperture radar (SAR), (2) a coastal imaging radar, (3) an offshore pressure-gage array, and (4) aerial photography. From the coastal radar images and aerial photographs, the direction and length of the principal wavetrains were measured by a manual analysis. The SAR images were processed using fast Fourier transform to give two-dimensional wave spectra. Scatter diagrams are presented which intercompare the measurements of all four systems, and show good agreement among all imaging systems. It is concluded that aerial photography and SAR will prove more useful when wave measurements are needed over a large area or when there are rapidly changing wave characteristics. O.C.

A81-43206 Iceberg detectability problems using SAR and SLAR systems. M. E. Kirby and R. T. Lowry (Intera Environmental Consultants, Ltd., Ottawa, Canada). In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979.

Minneapolis, MN, American Water Resources Association, 1981, p. 200-212. 10 refs. Research supported by the Intertech Remote Sensing, Ltd.

The application of synthetic aperture radar (SAR) and real aperture side-looking airborne radar (SLAR) systems for the identification of icebergs involves an understanding of the complicated interactions between the radar beams and the multi-faceted bergs. This paper summarizes the major problems that have been encountered in iceberg census research from selected portions of SLAR and SAR airborne experiments that were recently conducted. Since little radar iceberg data have been gathered from space satellites, the airborne systems offer attractive simulation possibilities. These systems have been used here to address such topics as iceberg detectability in relation to resolution, depression angle, sea clutter, and iceberg size and type. (Author)

A81-43244 Multispectral kelp resource surveys. J. R. Jensen (Georgia, University, Athens, GA), J. E. Estes (California, University, Santa Barbara, CA), and M. Mel (Geoscientific and Consulting, Playa Del Rey, CA). In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979.

Minneapolis, MN, American Water Resources Association, 1981, p. 533-542. 23 refs.

A multispectral approach to monitoring kelp resources is

reported. Four dates of high-altitude color-infrared aerial photography (1:125,000), four dates of Landsat digital imagery, and two dates of X-band radar imagery were analyzed yielding kelp acreage estimates for beds along the Southern California Bight. These estimates were compared with statistics compiled by a private photogrammetric engineering firm responsible for monitoring Southern California beds. The practicality of monitoring kelp using these remote sensing systems is discussed. (Author)

A81-43245 **Remote sensing of coastal pollutants using multispectral data.** W. Philpot and V. Klemas (Delaware, University, Newark, DE). In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979. Minneapolis, MN, American Water Resources Association, 1981, p. 543-549. 6 refs.

In this paper we describe an attempt to use Landsat multispectral imagery for detection and classification of pollutants in coastal waters. The analysis technique applied to the Landsat data is the eigenvector (principal components) analysis. This proved to be a fairly useful method for detecting iron acid waste off the coast of Delaware and in the New York Bight, and may prove a useful technique for inland waters as well. A qualitative relationship between the apparent water color and the concentration and depth of a pollutant is described. (Author)

A81-43246 * **Aerospace remote sensing of the coastal zone for water quality and biotic productivity applications.** E. B. Pritchard and R. C. Harriss (NASA, Langley Research Center, Marine and Applications Technology Div., Hampton, VA). In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979. Minneapolis, MN, American Water Resources Association, 1981, p. 550-562. 25 refs.

Remote sensing can provide the wide area synoptic coverage of surface waters which is required for studies of such phenomena as river plume mixing, phytoplankton dynamics, and pollutant transport and fate, but which is not obtainable by conventional oceanographic techniques. The application of several remote sensors (aircraftborne and spacecraftborne multispectral scanners, passive microwave radiometers, and active laser systems) to coastal zone research is discussed. Current measurement capabilities (particulates, chlorophyll a, temperature, salinity, ocean dumped materials, other pollutants, and surface winds and roughness) are defined and the results of recent remote sensing experiments conducted in the North Atlantic coastal zone are presented. The future development of remote sensing must rely on an integrated laboratory research program in optical physics. Recent results indicate the potential for separation of particulates into subsets by remote sensors. (Author)

A81-43247 **Digital analysis of Landsat MSS data and application for coastal marine environment.** H. Ochiai (Toba Merchant Marine College, Toba, Japan) and Y. Suzuki (Facom Information Processing Co., Tokyo, Japan). In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979. Minneapolis, MN, American Water Resources Association, 1981, p. 563-569.

This paper presents the techniques of image analysis of remote sensing data obtained by Landsat in the study of marine environment applications in the coastal area of Japan. In the analysis of remote sensing data for a specific object, thematic analysis with feature extraction and classification techniques for pattern recognition has become more popular. In the digital analysis, spectral characteristics of the data can be expressed quantitatively. Many flexible techniques can also be incorporated to find out the most effective method of analysis of remote sensing and field application. In an analysis of the marine environment, the classification per area is more effective than the classification per pixel. For relatively simple methods with a wide variety of application, methods have been developed in which imagery is classified and analyzed concerning the similarity of spectral data. (Author)

A81-43248 **Satellite observations of a geothermal submarine spring off Florida west coast.** F. A. Kohout (U.S. Geological Survey, Woods Hole, MA), R. C. Munson (NOAA, Norfolk, VA), R. M. Turner (U.S. Geological Survey, Reston, VA), and W. R. Royal. In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979. Minneapolis, MN, American Water Resources Association, 1981, p. 570-578. 20 refs.

A81-43250 **Combined satellite imagery for study of coastal circulation, Onslow Bay, North Carolina.** C. W. Welby and L. J. Pietrafesa (North Carolina State University, Raleigh, NC). In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979. Minneapolis, MN, American Water Resources Association, 1981, p. 585-592. 18 refs. Research supported by the North Carolina State University; U.S. Bureau of Land Management Contract No. 025-08; Contract No. EY-71-5-09-0902.

A photo-optical technique using satellite imagery has been devised to study surface and near surface circulation patterns in the shallow shelf waters of Raleigh and Onslow bays, North Carolina. The NOAA-5 VHRR thermal imagery was matched photographically to the scale of the Landsat 70 mm transparencies, and the transparencies were superimposed in a color additive viewer, taking advantage of the scaling and rotational capabilities of the viewer. Various combinations of filters together with positive and negative transparencies were used to enhance the imagery for interpretation. Through photographic enlargement and the projection capabilities of the viewer, imagery has been studied at scales between approximately 1:850,000 and 1:250,000. Combination of the imagery types enables the interpreter to differentiate between cold and warm water masses, to interpret circulation patterns at the instant of imaging, and to identify the patterns of suspended matter distribution and dispersion in the shallow bays. With this information the interpreter can improve his understanding of the relative effects of varying forces on water mass movement. (Author)

A81-43251 * **Satellite detection of oil on the marine surface.** M. J. Wilson, P. E. O'Neill (NASA, Washington, DC), and J. E. Estes (California, University, Santa Barbara, CA). In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979. Minneapolis, MN, American Water Resources Association, 1981, p. 593-602. 14 refs.

The ability of two widely dissimilar spaceborne imaging sensors to detect surface oil accumulations in the marine environment has been evaluated using broadly different techniques. Digital Landsat multispectral scanner (MSS) data consisting of two visible and two near infrared channels has been processed to enhance contrast between areas of known oil coverage and background clean surface water. These enhanced images have then been compared to surface verification data gathered by aerial reconnaissance during the October 15, 1975, Landsat overpass. A similar evaluation of oil slick imaging potential has been made for digitally enhanced Seasat-A synthetic aperture radar (SAR) data from July 18, 1979. Due to the premature failure of this satellite, however, no concurrent surface verification data were collected. As a substitute, oil slick configuration information has been generated for the comparison using meteorological and oceanographic data. The test site utilized in both studies was the extensive area of natural seepage located off Coal Oil Point, adjacent to the University of California, Santa Barbara. (Author)

A81-43539 * **Drift and dispersion studies of ocean-dumped waste using Landsat imagery and current drogues.** V. Klemas and W. D. Philpot (Delaware, University, Newark, DE). *Photogrammetric Engineering and Remote Sensing*, vol. 47, Apr. 1981, p. 533-542. 27 refs. Research supported by Du Pont de Nemours and Co.; Contract No. NAS5-20983.

The drift and dispersion of industrial acid wastes dumped 64 km off the Delaware coast were investigated using 16 Landsat images. Waste plume drift velocities and spread rates were obtained, and principal component analysis was performed to discriminate the acid waste from other pollutants. Waste plumes averaged drifting rates from 0.59 km/hr to 3.39 km/hr into the southwest quadrant, and remained above the thermocline, which formed at depths ranging from 13 m to 24 m. Rapid waste movement toward shore occurred primarily during storms, although plumes were rapidly dispersed and diluted at spread rates in excess of 4 cm/sec. Landsat data analysis also indicates plume width increase of about 1.5 cm/sec during calm

sea conditions, which is also in agreement with Falk's (1974) estimates of plume dilution. D.L.G.

A81-43967 # Features of the radar detection of sea surface nonuniformities (Osobennosti obnaruzheniia neodnorodnostei morskoi poverkhnosti radiolokatsionnym metodom). A. I. Kalmykov and A. P. Pichugin (Akademiia Nauk Ukrainskoi SSR, Institut Radiofiziki i Elektroniki, Kharkov, Ukrainian SSR). *Akademiia Nauk SSSR, Izvestiia, Fizika Atmosfery i Okeana*, vol. 17, July 1981, p. 754-761. 9 refs. In Russian.

Amplitude (mean and fluctuation) and spectral characteristics of radar scattering by both a uniform sea surface and nonuniformities in the form of slicks are presented. It is shown that scattering from slicks within a broad range of incidence angles can be described in the framework of a selective scattering model (the two-scale model). Using typical examples of obtained results, the possibilities of processing radar signals are discussed, with the aim of detecting slicks and determining their main parameters. J.F.

A81-44861 Satellite determination of the mesoscale variability of the sea surface temperature. P. Y. Deschamps, R. Frouin (Lille I, Université, Villeneuve-d'Ascq, Nord, France) and L. Wald (Paris, Ecole Nationale Supérieur des Mines, Valbonne, Alpes-Maritimes, France). *Journal of Physical Oceanography*, vol. 11, June 1981, p. 864-870. 21 refs. Research supported by the Centre National de la Recherche Scientifique, Centre National d'Etudes Spatiales, and Centre National pour l'Exploitation des Océans.

Satellite infrared data have been used to investigate the mesoscale variability of the SST (sea surface temperature) field. A statistical analysis of the SST field has been performed by means of the structure function. Results give the equivalent power-law exponent n of the spatial variance density spectrum. The exponent n was found to vary from 1.5 to 2.3 with a mean value of 1.8 in the range of scales 3-100 km which is in agreement with previous one-dimensional analysis from shipborne and airborne measurements. These observed values of n are discussed and compared with the values predicted by turbulence theories. A.L.W.

A81-45436 Particular features of the ocean glitter pattern observed from a sun-synchronous orbit. J. C. Kosik (Centre National d'Etudes Spatiales, Toulouse, France) and G. Paci (ESA, Earth Observation Programme Office, Toulouse, France). *International Journal of Remote Sensing*, vol. 2, July-Sept. 1981, p. 265-275. 6 refs.

An analysis method is developed to locate the point of maximum sea surface glitter for a scanner on a sun-synchronous orbit. A simulation of the ocean glitter effect is conducted, and sun glint avoidance methods are discussed. Results show the spread of the glitter pattern over a large area around the point of specular reflection. Patterns suggest symmetry features which may be used to develop a simplified analysis of the glitter problem. Possible benefits of the simplified computation method include the extension to any type of scanning system, and plotting the latitude and scanning angle of specular reflection for descending and ascending daylight passes respectively. The method is also applied to two specific problems, and the solutions are discussed. D.L.G.

A81-45861 Remote sensing of atmospheres and oceans; Proceedings of the Interactive Workshop on Interpretation of Remotely Sensed Data, Williamsburg, VA, May 23-25, 1979. Workshop sponsored by the U.S. Navy and Institute for Atmospheric Optics and Remote Sensing; Contract No. N00014-79-G-0039. Edited by A. Deepak (Institute for Atmospheric Optics and Remote Sensing, Hampton, VA). New York, Academic Press, Inc., 1980. 655 p. $45.

The workshop focused on the current state of knowledge as well as on the results of the latest investigations in the fields of remote sensing of oceanographic, terrestrial, and atmospheric quantities. Topics discussed include: recent advances in inversion methods, atmospheric temperature sounding, interpretation of aerosol sounding, and gaseous constituent retrievals. Other topics are: remote sounding by microwaves, sounding of sea surface temperature, ocean color, and winds, and interpretation of recent results from space. V.L.

A81-45881 Application of the truncated normal distribution technique to the derivation of sea surface temperatures. H. E. Fleming (NOAA, National Environmental Satellite Service, Washington, DC). In: Remote sensing of atmospheres and oceans; Proceedings of the Interactive Workshop on Interpretation of Remotely Sensed Data, Williamsburg, VA, May 23-25, 1979. New York, Academic Press, Inc., 1980, p. 503-544; Discussion, p. 545. Navy-supported research.

The truncated normal distribution technique is applied to the derivation of sea surface temperatures from high-resolution satellite measurements in the 11-micron window region. The purpose of this technique is to remove cloud contamination from the measurements. This procedure produces sea surface temperature maps on a mesoscale level so that a reasonably small-scaled temperature structure, such as that found in the Gulf Stream, can be determined. Because not all the cloud contamination is removed by the truncated normal distribution technique, the resulting temperature fields are modified by an error detection and correction technique. Results from both simulated and real data are presented. No attempt has been made to account for atmospheric attenuation by water vapor; therefore, the results are accurate in only a relative sense. (Author)

A81-46104 Spaceborne synthetic aperture radar for oceanography. Edited by R. C. Beal (Johns Hopkins University, Laurel, MD), P. S. DeLeonibus (NOAA, Washington, DC), and I. Katz (Johns Hopkins University, Laurel, MD). Baltimore, MD, Johns Hopkins University Press (Johns Hopkins Oceanographic Studies, No. 7), 1981. 215 p. $19.50.

Topics discussed include the structure of short gravity waves on the ocean surface, the statistical characteristics of wind generated short gravity waves, and SAR ocean imaging mechanisms. Papers are presented on the variability of winds over the ocean, the problems in ocean wave hindcasting, and surface signs of internal ocean dynamics. C.R.

A81-46105 * The structure of short gravity waves on the ocean surface. O. M. Phillips (Johns Hopkins University, Baltimore, MD). In: Spaceborne synthetic aperture radar for oceanography. Baltimore, MD, Johns Hopkins University Press, 1981, p. 24-31. 14 refs. NASA-supported research.

A brief review is given of the salient properties of short gravity waves and the way in which their structure is modified by longer waves or swell, by variable currents, and by internal waves. It is noted that an underlying swell produces a mottled pattern in synthetic aperture radar (SAR) imagery, and an expression is derived giving the fractional modulation in backscattering cross section of the ocean surface in terms of the slope of an underlying swell, the wind direction, and the direction of swell propagation relative to the angle of observation. The expression provides the possibility in appropriate circumstances of estimating the swell slope by remote sensing, in addition to the wavelength and direction of propagation, which can be measured directly from the imagery. An account is also given of the refraction of waves in variable currents and internal waves. C.R.

A81-46107 SAR ocean imaging mechanisms. R. O. Harger (Maryland, University, College Park, MD). In: Spaceborne synthetic aperture radar for oceanography. Baltimore, MD, Johns Hopkins University Press, 1981, p. 41-52. 14 refs.

It is noted that in applying synthetic aperture radar (SAR) to oceanography the basic SAR theory must be extended to account for scattering from a time-varying surface that satisfies nonlinear hydrodynamic restraints. A model that assumes a two-scale ocean surface is discussed. Nonlinear electromagnetic and hydrodynamic interactions produce a complex image dependence on the two scales. A spectral expansion of the image is given, and the contributions from the nonlinear interactions and scattering mechanism are identified. Under certain conditions, the image is a linear, space-variant transformation, decomposable into three more easily understood transformations, of an effective reflectivity density at a reference time. C.R.

A81-46109 # The wind speed dependency of ocean microwave backscatter. D. B. Ross (NOAA, Sea-Air Interaction Laboratory, Miami, FL). In: Spaceborne synthetic aperture radar fo

oceanography. Baltimore, MD, Johns Hopkins University Press, 1981, p. 75-86. 21 refs.

Seasat SAR imagery of the ocean is analyzed in terms of the forcing atmosphere and the forcing ocean. In comparison with other types of measurements of surface wind speed, rainfall, wave roughness conditions, and air-sea temperature differences, it is found that the short ocean waves responsible for the radar backscatter are strongly coupled to the local wind and are modulated by rainfall rate and air-sea temperature differences, especially when the sign of the difference is changing rapidly. C.R.

A81-46110 * # **The study of mesoscale ocean winds.** W. L. Jones, E. M. Bracalente (NASA, Langley Research Center, Hampton, VA), and V. E. Delnore (Kentron International, Inc., Hampton, VA). In: Spaceborne synthetic aperture radar for oceanography. Baltimore, MD, Johns Hopkins University Press, 1981, p. 87-94. 11 refs.

SAR data gathered over the U.S. East Coast are used to infer near-surface wind speed, using a simplified model to relate the strength of the 30 to 40 cm SAR backscatter to surface wind speed. It is found that the SAR backscatter is nearly isotropic with a wind speed exponent of 0.4. Using this exponent, the model is tested against an independent data set. Subsequent agreement between wind speeds simultaneously determined by SAR and the Seasat-A Satellite Scatterometer (SASS) is within 0.7 m/s rms. A one-dimensional Fourier transform of the SAR-derived wind field shows an increasing energy content in rough agreement with the Van der Hoven spectrum. C.R.

A81-46112 * **Spatial evolution of ocean wave spectra.** R. C. Beal (Johns Hopkins University, Applied Physics Laboratory, Laurel, MD). In: Spaceborne synthetic aperture radar for oceanography. Baltimore, MD, Johns Hopkins University Press, 1981, p. 110-127. 24 refs. NASA-Navy-supported research; Contract No. NOAA-MO-A01-78-00-4330.

The spatially evolving deep water synthetic aperture radar (SAR) directional spectra of a mixed ocean wave system are compared with a comprehensive set of surface and aircraft measurements. The evolution of the SAR spectra, at least for ocean wavelengths greater than 80 m, is seen as generally consistent with the auxiliary data set in both time and space. From the spatial evolution of the angular component of the spectra, it is possible to project back to an apparent remote storm source that is also consistent with the storm location via GOES satellite imagery. The data provide compelling evidence that the spatial evolution of SAR ocean wave spectra can be a useful tool in global ocean wave monitoring and forecasting. C.R.

A81-46113 * **Refraction of coastal ocean waves.** R. A. Shuchman and E. S. Kasischke (Michigan, Environmental Research Institute, Ann Arbor, MI). In: Spaceborne synthetic aperture radar for oceanography. Baltimore, MD, Johns Hopkins University Press, 1981, p. 128-135. 16 refs. NASA-supported research; Contract No. NOAA-MO-A01-78-00-4339.

Refraction of gravity waves in the coastal area off Cape Hatteras, NC as documented by synthetic aperture radar (SAR) imagery from Seasat orbit 974 (collected on September 3, 1978) is discussed. An analysis of optical Fourier transforms (OFTs) from more than 70 geographical positions yields estimates of wavelength and wave direction for each position. In addition, independent estimates of the same two quantities are calculated using two simple theoretical wave-refraction models. The OFT results are then compared with the theoretical results. A statistical analysis shows a significant degree of linear correlation between the data sets. This is considered to indicate that the Seasat SAR produces imagery whose clarity is sufficient to show the refraction of gravity waves in shallow water. C.R.

A81-46115 # **Detection of the Gulf Stream.** R. M. Hayes (U.S. Coast Guard, Washington, DC). In: Spaceborne synthetic aperture radar for oceanography. Baltimore, MD, Johns Hopkins University Press, 1981, p. 146-160. 44 refs.

Aircraft and satellite thermal infrared and visual indicators are used to locate Gulf Stream boundaries, which are compared with those apparent in Seasat synthetic aperture (SAR) imagery. Emphasis in the analysis is on orbits 400 and 931, which capture the semipermanent Gulf Stream meander that develops when the current passes over the Charleston Rise. Results demonstrate that identifiable linear features in the SAR imagery are correlated with the current velocity shear zone. Gulf Stream detection is seen as related to modulation of the small gravity wave field at the boundary of the swift current yielding long, distinct, linear features in the radar imagery. It is noted that tonal and/or textural contrast of the water within and outside the Gulf Stream arising from a sea surface temperature-induced difference in the effect of wind stress on surface roughness may also contribute to Gulf Stream detection. Backscatter measurements made along transects across the Gulf Stream are given in order to characterize the signature of a SAR-to-scene transfer function that reveals the nature of the Gulf Stream radar cross section at the boundaries. C.R.

A81-46116 * # **A search for cold water rings.** R. E. Cheney (NASA, Goddard Space Flight Center, Greenbelt, MD). In: Spaceborne synthetic aperture radar for oceanography. Baltimore, MD, Johns Hopkins University Press, 1981, p. 161-170. 23 refs.

SAR imagery obtained by Seasat in the Sargasso Sea during 1978 is examined for cold ring signatures. One orbit on August 26 is thought to have imaged the edge of a cold ring, although the ring's position was not well known at the time. During another orbit on September 23, drifting buoy and expendable bathythermography data furnished conclusive evidence that the ring was centered directly in the SAR swath. Although some suggestive patterns are visible in the images, it is not clear that cold rings can be identified by SAR, even though dynamically similar features, such as the Gulf Stream and warm rings, can be accurately detected. The suggestion is made that cold rings may be imaged inadequately because of their lack of surface temperature gradient. C.R.

A81-46117 # **Tracking of a warm water ring.** D. E. Lichy, M. G. Mattie, and L. J. Mancini (U.S. Army, Coastal Engineering Research Center, Fort Belvoir, VA). In: Spaceborne synthetic aperture radar for oceanography. Baltimore, MD, Johns Hopkins University Press, 1981, p. 171-182. 7 refs.

The imaging of a warm water ring off the East Coast of the U.S. by the Seasat synthetic aperture radar (SAR) on descending orbit six times during September and October of 1978 is discussed. The location and microwave response of SAR imagery for the rings are compared with NOAA-5 thermal infrared imagery and frontal analysis maps from the U.S. Naval Oceanographic Office. Centers of the rings are found to coincide within about 10 km. The diameters of the warm water rings delineated on the SAR imagery turn out to be smaller than on NOAA-5 imagery. The distinguishing features of the warm water ring area on the SAR imagery are concentric curvilinear features less than 1 km wide and as long as 150 km. The ability of the SAR to track warm water rings and the type of microwave return are discussed. C.R.

A81-46919 # **Nimbus-7 Coastal-Zone Colour Scanner data processing for Earthnet - Experience to date.** L. Fusco (ESA, Earthnet Programme Office, Frascati, Italy). *ESA Bulletin*, no. 27, Aug. 1981, p. 36-42.

A status report is given for the Earthnet program office's acquisition, preprocessing, archiving and distribution to users of Coastal Zone Color Scanner (CZCS) data from the Nimbus-7 satellite. These data are being used to demonstrate the usefulness of satellite coastal waters monitoring in such major issues as: (1) the optimum qualification and quantification of suspended materials and (2) definition of the requirements for future ocean monitoring equipment. In addition to detailed tabulations of Nimbus-7 and CZCS performance parameters, a list is given of the individual research objectives of the European countries participating in the data sharing program and examples are given of raw data products, system-corrected products, geophysical data products, and the Nimbus-7 CZCS data catalogue. O.C.

A81-47004 # **Correlation between integral and spectral albedos of clouds over water surfaces (Sootnoshenie integral'nogo i spektral'nogo al'bedo oblakov nad vodnoi poverkhnost'iu).** V. I. Binenko. In: Radiation studies in the atmosphere. Leningrad, Gidrometeoizdat, 1980, p. 29-32. 5 refs. In Russian.

An analysis is presented of airborne measurements conducted during 1971-1972 in the framework of the KENEX cloud program;

cumulus cloud cover over the Black Sea, the Sea of Azov, the Karskii Sea, and Ladozhskii Lake was investigated. The results were used to determine correlations between integral (0.3-3.0 microns) and spectral (0.6-0.92, 0.76, 0.69-0.74, 0.4-0.65, 0.676, 0.457, 0.391, and 0.369 micron) cloud albedos over water surfaces. F.G.M.

A81-47021 # **Application of GOES visible-infrared data to quantifying mesoscale ocean surface temperatures.** G. A. Maul (NOAA, Atlantic Oceanographic and Meteorological Laboratories, Miami, FL). *Journal of Geophysical Research,* vol. 86, Sept. 20, 1981, p. 8007-8021. 29 refs. Research supported by the U.S. Department of Energy.

The investigation is concerned with the possibility to use data from the Geostationary Operational Environmental Satellite (GOES) for the solution of sea surface temperature problems, taking into account the Gulf of Mexico as the test area because it is ringed with upper air stations from which atmospheric corrections can be calculated. A theoretical error analysis, with which to explain the + or - 1 to + or - 4 K errors being reported, is conducted. On the basis of the error analysis, an objective procedure is developed to quantify the satellite-derived temperatures from GOES at an acceptable level of accuracy. The procedure is applied to the Gulf of Mexico for October 1977. In the considered case, data from two research ships are available to serve as surface verification information. The described procedure, which is labor intensive, is not considered as an alternative to the GOSSTCOMP. The goal is rather to determine with it the temperature patterns well enough so that they may be used to study the physics of certain dynamical oceanographic processes. G.R.

A81-47022 Satellite-tracked drift buoy observations of the near-surface flow in the eastern mid-latitude North Pacific. G. J. McNally (California, University, La Jolla, CA). *Journal of Geophysical Research,* vol. 86, Sept. 20, 1981, p. 8022-8030. 20 refs. Contract No. N00014-75-C-0152.

The considered observations show that the large-scale coherent flow is essentially always along the isobars of sea level pressure, 20 - 30 deg to the right of the surface winds, at approximately 1.5% of the wind speed during the periods of strong persistent atmospheric forcing normally observed in the fall, winter, and spring seasons. Mesoscale energetics with time and length scales of 30 days and 100 km are clearly seen in near surface flow in the summer months. The large-scale, coherent flow observed during the fall through spring seasons is essentially unaltered over the upper 30 m of the mixed layer. Vertical shear in the large-scale flow is clearly observed when the drifters are drogued to depths of 100 m or more. This suggests that the drogulng technique used is effective and therefore the lack of difference in the current observations of undrogued drifters and those drogued at 30 m is due to a lack of vertical shear in the horizontal currents over the upper 30 m during periods of strong persistent atmospheric forcing. G.R.

A81-47099 Remote sounding of atmosphere and ocean for climate research /Appleton Lecture/. J. T. Houghton (Science Research Council, Rutherford and Appleton Laboratories, Chilton, Oxon, England). *IEE Proceedings, Part A - Physical Science, Measurement and Instrumentation, Management and Education, Reviews,* vol. 128, pt. A, no. 6, Sept. 1981, p. 442-448. 23 refs.

A description is presented of different types of satellite-borne remote sounding techniques of importance for the World Climate Research Program (WCRP). The WCRP is concerned with the attainment of a better understanding of climate and climatic change, particularly on time scales in the range from weeks to decades. The Global Atmospheric Research Program culminated in 1979 in the Global Weather Experiment, during which the atmosphere was observed as completely as possible for the period of a year. The purpose of the Global Weather Experiment was to investigate to what extent the atmosphere's large-scale circulation can be modelled and predicted by large numerical models. A particularly important remote sounding measurement from satellites is that of the temperature structure of the atmosphere below the satellite. In the case of remote temperature sounding, it is necessary to improve operational algorithms and procedures which make more complete use of the data. Improved sampling is needed for radiation-budget measurements. G.R.

A81-47344 The first ESA remote sensing satellite /ERS/ - The programme and the system. D. Lennertz and C. Honvault (ESA, Earth Observation Programme Dept., Toulouse, France). *International Astronautical Federation, International Astronautical Congress, 32nd, Rome, Italy, Sept. 6-12, 1981, Paper 81-90.* 14 p.

The European Space Agency is currently developing the first ESA Remote Sensing Satellite (ERS) system which will, as its first mission, monitor the ice and ocean regions. The objectives of the mission are both to increase scientific understanding of coastal zones and ocean processes and to develop economic applications related to a better knowledge of ocean parameters and sea state conditions. The payload of ERS-1 includes: (1) active microwave instrumentation, combining the functions of a synthetic aperture radar, a wave scatterometer, and a wind scatterometer, in order to measure wind fields and wind spectra; (2) a radar altimeter, for measuring significant wave heights; and (3) an ocean color monitor for measuring sea surface temperature and ocean color. The ERS-1 payload will be launched by ARIANE-2 in 1987 on a sun-synchronous orbit at 675 km. It will provide worldwide coverage, compatible with the duty cycles of its payload instruments and ensure real time acquisition through its own station network. The resulting data products will be listed by level, ranging from raw data to quick-look data to preprocessed products. Various ground segments associated with the satellite are presented. J.F.

A81-47348 Radar altimeter for ocean remote sensing. S. Pardini, R. Ronconi, R. Somma (Selenia S.p.A., Rome, Italy), and G. Picardi (Roma, Università, Rome, Italy). *International Astronautical Federation, International Astronautical Congress, 32nd, Rome, Italy, Sept. 6-12, 1981, Paper 81-94.* 10 p. European Space Agency Contract No. 4428/80.

Ocean radar altimetry is based on the electromagnetic back-scattering of the ocean surface in response to a narrow pulse waveform under near normal incidence. The altimeter described is used to determine the satellite altitude over the sea surface, the significant wave height, and wind speeds. The instrument requires accuracy, implying high precision in radar measurements of the pertinent return echo parameters. Problem areas such as pull-in phase initialization and tracking phase are discussed and the adopted solution includes using two separated loops. The RF/IF unit and the signal processor are also discussed. A radar altimeter functional block diagram is given, as are error signals of range and slope discrimators and the deterministic simulation of loops operation. Finally the main parameters include a peak power of 400 W, a frequency of 13.5 GHz and an antenna gain of 40 dB. J.F.

A81-48548 # **The National Oceanic Satellite System.** W. J. Hussey (NOAA, National Earth Satellite Service, Suitland, MD). In: EASCON '80; Electronics and Aerospace Systems Conference, Arlington, VA, September 29-October 1, 1980, Conference Record. New York, Institute of Electrical and Electronics Engineers, 1980, p. 295-305.

It is noted that satellites equipped with microwave sensors will make possible the collection of oceanic data on a global basis under all weather conditions. The National Oceanic Satellite System (NOSS), which will provide a five-year operational demonstration of satellite sensing of oceanic phenomena, is described. The system will measure parameters characterizing the wind, sea surface temperature, waves, ice, water mass definition, and horizontal surface currents. The benefits expected from NOSS are listed. They include improvements in sea ice boundary analyses, which will assist fishing operations near the ice edge, and improvements in the ability to forecast severe storms. Each of NOSS's primary sensors - the Scatterometer, Altimeter, Coastal Zone Color Scanner, and Large Antenna Multichannel Microwave Radiometer - is described, and a table giving sensor characteristics is included. C.R.

A81-48681 # **Infrared imagery for studying the Kara-Bogaz-Gol Bay (Teplovaia s'emka pri izuchenii zaliva Kara-Bogaz-Gol).** V. I. Gornyi (Vsesoiuznoe Aerogeologicheskoe Nauchno-Proizvodstvennoe Ob'edinenie Aerogeologiia, Leningrad, USSR). *Issledovanie Zemli iz Kosmosa,* July-Aug. 1981, p. 11-17. 8 refs. In Russian.

Results of theoretical and experimental studies of the thermal field of the surface of the salt stratum of the Kara-Bogaz-Gol Bay

and several dry salt lakes of West Turkmenia are presented. The dependence of diurnal fluctuations of the surface temperature of the moist salt stratum on the air humidity is shown. To substantiate the possibility of using infrared satellite imagery for studying the salt stratum of the Bay, aerial infrared images of the salt cover are presented, illustrating the good imaging properties of the surface's thermal field relative to the composition, structure, and moisture of the salt. It is concluded that infrared satellite imagery can be used to study the hydrological and hydrochemical conditions of the Bay. J.F.

A81-48687 # **An analysis of the data of synchronous measurements from the Meteor satellite and ships at the eastern coast of the Caspian Sea (Analiz dannykh sinkhronnykh izmerenii s ISZ 'Meteor' i sudov u Vostochnogo poberezh'ia Kaspiiskogo Moria).** G. P. Vaniushin, V. N. Diadiunov, and S. M. Sazhin (Vsesoiuznyi Nauchno-Issledovatel'skii Institut Morskogo Rybnogo Khoziaistva i Okeanografii; Gosudarstvennyi Nauchno-Issledovatel'skii Tsentr Izucheniia Prirodnykh Resursov, Moscow, USSR). *Issledovanie Zemli iz Kosmosa*, July-Aug. 1981, p. 54-60. 16 refs. In Russian.

Data were obtained from synchronous measurements by the Meteor satellite and ships at the eastern coast of the Caspian Sea on Sept. 22, 1978. Results of the investigation, which involved 26 hydrological stations, were used to show the relationship between the brightness of the water medium, the concentration of chlorophyll, the suspension of inorganic matter, and the values of relative transparency. J.F.

A81-49126 **Satellites for oceanography - The promises and the realities.** R. Goody (Harvard University, Cambridge, MA). *Oceanus*, vol. 24, Fall 1981, p. 3-5.

The problems encountered in assimilating satellite data into oceanographic research are discussed. The possibilities offered by satellites are illustrated by describing the Coastal Zone Color Scanner, the infrared sounder, the active radar scatterometer, and the synthetic aperture radar. It is stressed that remote sensing techniques from satellites are here to stay, and the oceanographic community is urged to embrace them. It is pointed out that if oceanographic science is to profit to a maximum, planning must start for combinations of measurements from satellites, aircraft, buoys, ships, and islands. C.R.

A81-49127 * **Oceanography from satellites.** W. S. Wilson (NASA, Oceanic Processes Branch, Washington, DC). *Oceanus*, vol. 24, Fall 1981, p. 9-16. 14 refs.

It is pointed out that oceanographers have benefited from the space program mainly through the increased efficiency it has brought to ship operations. For example, the Transit navigation system has enabled oceanographers to compile detailed maps of sea-floor properties and to more accurately locate moored subsurface instrumentation. General descriptions are given of instruments used in satellite observations (altimeter, color scanner, infrared radiometer, microwave radiometer, scatterometer, synthetic aperture radar). It is pointed out that because of the large volume of data that satellite instruments generate, the development of algorithms for converting the data into a form expressed in geophysical units has become especially important. C.R.

A81-49128 **The promise of satellite altimetry.** C. Wunsch (MIT, Cambridge, MA). *Oceanus*, vol. 24, Fall 1981, p. 17-26. 5 refs.

The contributions that an altimetric satellite could make to oceanography are discussed. It is noted that such a satellite would provide a global view of the surface elevation of the ocean every few days. Since the surface elevation can be related to the velocity at depth fairly easily, a new altimetric mission could give a fast, quantitative measure of the state of the ocean. But its real value is that by combining altimetric measurements with the equations of motion, the altimeter could be used to provide accurate data for numerical models of the global circulation, both to analyze the state of the sea and, potentially, to forecast it. A description is given of the Ocean Topography Experiment (Topex). C.R.

A81-49129 **The future for satellite-derived surface winds.** J. J. O'Brien (Florida State University, Tallahassee, FL). *Oceanus*, vol. 24, Fall 1981, p. 27-31.

It is noted that cautious agreement exists that the scatterometer is capable of measuring wind speed in many weather situations to within 2 meters per second (approximately 5 miles per hour). It is also able to measure wind direction. If the orbit of a satellite carrying a scatterometer were adjusted to altitudes of about 2,400 km, the satellite could cover the entire globe in a few days. For the first time, it would be possible to have a global distribution of wind estimates every week or so. What is more, with a satellite wind-observing system, the Ekman drift current could be calculated on a regular basis. These estimates could be used for search and rescue operations, as well as for pollution transport problems. C.R.

A81-49130 * # **Remote sensing in biological oceanography.** W. E. Esaias (NASA, Langley Research Center, Hampton, VA). *Oceanus*, vol. 24, Fall 1981, p. 32-38.

The main attribute of remote sensing is seen as its ability to measure distributions over large areas on a synoptic basis and to repeat this coverage at required time periods. The way in which the Coastal Zone Color Scanner, by showing the distribution of chlorophyll a, can locate areas productive in both phytoplankton and fishes is described. Lidar techniques are discussed, and it is pointed out that lidar will increase the depth range for observations. C.R.

A81-49132 **Climate, the oceans, and remote sensing.** F. P. Bretherton (National Center for Atmospheric Research, Boulder, CO). *Oceanus*, vol. 24, Fall 1981, p. 49-55.

It is noted that an understanding of the workings of the climate system and an ability to predict year-to-year variations and long-term changes resulting from man's activities will require extensive observations of the ocean. The surface temperature and flux of heat through the surface are identified as key variables for the atmospheric circulation. The wind stress on the surface and the net of evaporation less rainfall are also seen as important factors in oceanic circulation. The long-term redistribution of heat by the ocean currents and year-to-year fluctuations in heat storage are identified as central climatic variables. It is thought that satellite observations, because of their global perspective, may play a key role in many of these areas. C.R.

A81-49133 * **Commercial applications of satellite oceanography.** D. R. Montgomery (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA). *Oceanus*, vol. 24, Fall 1981, p. 56-65. 11 refs. Contract No. NAS7-100.

It is shown that in the next decade the oceans' commercial users will require an operational oceanographic satellite system or systems capable of maximizing real-time coverage over all ocean areas. Seasat studies suggest that three spacecraft are required to achieve this. Here, the sensor suite would measure surface winds, wave heights (and spectral energy distribution), ice characteristics, sea-surface temperature, ocean colorimetry, height of the geoid, salinity, and subsurface thermal structure. The importance of oceanographic data being distributed to commercial users within two hours of observation time is stressed. Also emphasized is the importance of creating a responsive oceanographic satellite data archive. An estimate of the potential dollar benefits of such an operational oceanographic satellite system is given. C.R.

A81-49378 **Compact and highly sensitive fluorescence lidar for oceanographic measurements.** U. Gehlhaar, K. P. Gunther, and J. Luther (Oldenburg, Universität, Oldenburg, West Germany). *Applied Optics*, vol. 20, Oct. 1, 1981, p. 3318-3320. 12 refs. Research supported by the Deutsche Forschungsgemeinschaft.

A compact and highly sensitive helicopter-borne fluorescence lidar is described. The single channel system is based on a high power, tunable laser. From an altitude of 70 m, selective detection of the tracer dye rhodamine B of less than 10 to the -10th g/cu cm in natural waters is achieved. (Author)

A81-49426 # **Theoretical investigations concerning the measurement of the plankton concentration with the aid of satellites (Theoretische Untersuchungen zur Messung der Plaktonkonzentration mit Hilfe von Satelliten).** G. Metzig (Köln, Universität, Cologne, West Germany) and M. Kerschgens (Bonn, Universität, Bonn, West Germany). *(Deutsche Meteorologen-Tagung und Internationales Alfred-Wegener-Symposium, Berlin, West Germany, Feb. 25-29, 1980.) Annalen der Meteorologie*, no. 15, 1980, p. 154, 155. 5 refs. In German.

A description is presented of a theoretical model which provides information regarding the possibilities to determine plankton concentrations in the ocean by remote sensing. The model makes use of the theory of radiation transport. Radiative flux in the ocean and radiation densities in the atmosphere are computed for fifteen spectral intervals in the range from 0.3 to 0.76 micrometers. The mathematical procedure consists of a combination of an iterative solution scheme and a modified two-stream method. The preliminary objective of the considered study is related to a calculation of the change in the surface albedo of the sea by plankton, and the possibilities which exist for measuring this change with an instrument located at the upper boundary of the atmosphere. G.R.

A81-49649 # **Atlantic hurricane season of 1980.** M. B. Lawrence and J. M. Pelissier (NOAA, National Hurricane Center, Miami, FL). *Monthly Weather Review,* vol. 109, July 1981, p. 1567-1582.

A summary of the 1980 hurricane season is presented. Eleven named tropical cyclones were tracked, of which nine reached hurricane force. Allen, an intense storm, affected a number of Caribbean countries before making landfall on the Texas coast.
(Author)

A81-49656 # **The occurrence of vertical tilt in tropical cyclones.** J. E. Huntley and J. W. Diercks (U.S. Navy, Naval Oceanography Command Center - Joint Typhoon Warning Center, GU). *Monthly Weather Review,* vol. 109, Aug. 1981, p. 1689-1700. 8 refs.

Satellite imagery and aircraft reconnaissance data are presented to show that the tropical cyclones of the western North Pacific often possess significant horizontal displacements between their surface and 700 mb circulation centers during the development stage. Because of the frequency of aircraft reconnaissance during their existence and the range of peak intensities recorded, Super Typhoon Tip, Typhoon Abby and Tropical Depression 01 were selected to illustrate this phenomenon. This observational evidence raises questions as to whether: (1) the displacement between surface and upper level centers are related to the fields of convergence which are necessary to organize and intensify a tropical cyclone, or merely a reaction to upper level shearing flow; and (2) a numerical model initialized with a weak, sloping vortex would spin up to typhoon strength. O.C.

A81-49657 # **Eastern North Pacific tropical cyclones of 1980.** E. B. Gunther (NOAA, Eastern Pacific Hurricane Center, Redwood City, CA). *Monthly Weather Review,* vol. 109, Aug. 1981, p. 1701-1712.

A81-49754 # **Operational use of satellite imagery in the Canadian ice program.** T. F. Mullane (Ice Forecasting Central, Ottawa, Canada). In: Canadian Symposium on Remote Sensing, 6th, Halifax, Canada, May 21-23, 1980, Proceedings.
Ottawa, Canadian Aeronautics and Space Institute, 1981, p. 17-32. 7 refs.

The need to provide timely and accurate ice information in support of marine transportation and offshore exploration has increased steadily in recent years. The near real-time reception of NOAA and Landsat imagery provides comprehensive and detailed information on ice conditions. This paper reviews the development and operational use of satellite imagery at Ice Forecasting Central. Imagery acquisition, enhancement, and analysis are considered. The capabilities and limitations of the imagery for the definition of ice features are examined, and developments in automated interpretation processes are presented. B.J.

A81-49758 # **The use of satellite imagery as an aid to the Canadian Coast Guard ice operations.** B. Dawe (Remotec Applications, Inc., St. John's, Newfoundland, Canada), A. Collins (Canada Centre for Remote Sensing, Ottawa, Canada), L. Humphries, and G. Warren (Canadian Coast Guard, St. John's, Newfoundland, Canada). In: Canadian Symposium on Remote Sensing, 6th, Halifax, Canada, May 21-23, 1980, Proceedings. Ottawa, Canadian Aeronautics and Space Institute, 1981, p. 53-61. 5 refs.

A81-49771 # **Airborne impulse radar sounding of sea ice.** J. R. Rossiter, K. A. Butt, J. B. Gamberg, and T. F. Ridings (Newfoundland, Memorial University, St. John's, Canada). In: Canadian Symposium on Remote Sensing, 6th, Halifax, Canada, May 21-23, 1980, Proceedings. Ottawa, Canadian Aeronautics and Space Institute, 1981, p. 187-194. 14 refs. Research supported by the Canadian Marine Drilling, Ltd., Esso Resources Canada, Ltd., and National Research Council of Canada; Department of Supply and Services Contract No. 1SU-78-00347.

Airborne impulse radar, operated from a helicopter and a Twin-Otter, was used in March-April 1979 to estimate the physical properties of sea ice in the Beaufort Sea and Lake Melville, Labrador. Concurrent measurements included: thickness, salinity, temperature, crystal fabric, electrical properties of the ice, simultaneous aerial photography, and synthetic aperture radar imagery. Impulse radar center-frequencies of 80, 100, and 200 MHz appear to give the best trade-off of penetration vs resolution and antenna size. Data collected below 30 m elevation have reduced side-scatter from the ice surface. Speeds below 50 m/s are required with the current hardware to achieve coherence from scan-to-scan. Thickness estimates are excellent for fresh and brackish ice, and are good for underformed first-year sea ice about 1-2 m thick. Areas of fresh water melt pools that have only experienced surface refreezing show thickness profiles that warrant further examination. Bottom returns from multilayer ice are sporadic, although floes up to 14 m have been sounded. Ridges are not usually penetrated, but can be easily detected.
(Author)

A81-49772 # **The Lake Melville/Labrador offshore synthetic aperture radar study - Winter 1979.** R. D. Worsfold, S. K. Parashar, and D. C. Strong (Remotec Applications, Inc., St. John's, Newfoundland, Canada). In: Canadian Symposium on Remote Sensing, 6th, Halifax, Canada, May 21-23, 1980, Proceedings.
Ottawa, Canadian Aeronautics and Space Institute, 1981, p. 195-202. 11 refs. Research supported by the Newfoundland Department of Regional and Economic Expansion.

A81-49774 # **Single and multiple parameter microwave signatures of sea ice.** R. E. Hawkins, C. E. Livingstone, A. L. Gray (Canada Centre for Remote Sensing, Ottawa, Canada), K. Okamoto (Ministry of Posts and Telecommunications, Radio Research Laboratories, Tokyo, Japan), L. D. Arsenault (Cold Regions Remote Sensing, Stittsville, Ontario, Canada), D. Pearson (Intera Environmental Consultants, Ltd., Ottawa, Canada), and T. L. Wilkinson (Waterloo, University, Waterloo, Ontario, Canada). In: Canadian Symposium on Remote Sensing, 6th, Halifax, Canada, May 21-23, 1980, Proceedings. Ottawa, Canadian Aeronautics and Space Institute, 1981, p. 217-229. 19 refs.

Simultaneous 13.3 GHz dual-polarized fanbeam scatterometer data, 19.35 GHz horizontally polarized profiling radiometer data and nadir-looking aerial photography with corresponding X- and L-band SAR (Synthetic Aperture Radar) imagery were collected with the CCRS Convair-580 in March 1979 in the Beaufort Sea and in the eastern Arctic in April 1979. This data set was analyzed to compile statistics on 11 WMO (World Meteorological Organization) classes of sea ice, ranging from calm open water to multiyear ice and ice island.
(Author)

A81-49775 # **Radar detection of sea-ice ridges and icebergs in frozen oceans at incidence angles from 0 deg to 90 deg.** D. Pearson (Intera Environmental Consultants, Ltd., Ottawa, Canada), C. E. Livingstone, R. K. Hawkins, A. L. Gray (Canada Centre for Remote Sensing, Ottawa, Canada), L. D. Arsenault (Cold Regions for Remote Sensing, Stittsville, Ontario, Canada), T. L. Wilkinson (Waterloo, University, Waterloo, Ontario, Canada), and K. Okamoto (Ministry of Posts and Telecommunications, Radio Research Laboratories, Tokyo, Japan). In: Canadian Symposium on Remote Sensing, 6th, Halifax, Canada, May 21-23, 1980, Proceedings.
Ottawa, Canadian Aeronautics and Space Institute, 1981, p. 231-241. 5 refs.

Dual-polarized 13.3 GHz scatterometer data and X-band SAR data, collected in the Beaufort Sea and in the eastern Arctic, during the SURSAT sea-ice experiment deployments in March 1979 and April 1979 respectively, have been analyzed to determine the radar contrasts (signal to sea-ice clutter) between sea-ice ridges and the surrounding sea ice in the Beaufort Sea and between icebergs and the

surrounding sea ice in the eastern Arctic. The effects of radar resolution cell size on ridge detectability were examined using aerial photography to estimate ridge dimensions. Over the incidence angle range observed, the contrast between ridges and the surrounding sea-ice is nearly independent of incidence angle for all ice types. Cross-polarized radars produce larger ridge contrasts than like-polarized radars, with the largest contrasts and greatest polarization dependence being observed for rough first-year ridges in smooth first-year ice and the smallest contrasts and least polarization dependence being observed for multiyear ridges in multiyear ice. The contrast between icebergs and the first-year ice background is nearly independent of incidence angle over the observed range. Cross-polarized radars enhance iceberg detectability but synthetic aperture radars operated at satellite incidence angles are found to be unsuitable for iceberg detection. (Author)

A81-49776 # **SAR processing of partially coherent and sinusoidally dynamic ocean waves.** R. K. Raney (Canada Centre for Remote Sensing, Ottawa, Canada). In: Canadian Symposium on Remote Sensing, 6th, Halifax, Canada, May 21-23, 1980, Proceedings. Ottawa, Canadian Aeronautics and Space Institute, 1981, p. 243-247. 6 refs.

The surface of the ocean as observed by a Synthetic Aperture Radar (SAR) evidences both random and deterministic dynamics that have a major impact on the resulting image. This paper explores selected image properties when both effects are present. It is shown that the average response of the SAR is not sensitive to misfocus, whether caused by processor maladjustment or scene dynamics. On the other hand, impulse response and frequency response are critically affected by focus, with a sensitivity that is proportional to the space-bandwidth product of the SAR. Thus, accelerations in a wave scene cannot give rise to wave-like contrasts already present. Orbital motions of surface reflecting wavelets may cause a Doppler shifted image position to occur, which will lead to wave-like contrasts in the image if focus and coherence are maintained. This paper points out that the shift is constant with range for azimuthal waves. In contrast, range dependence occurs in most azimuthal SAR wave imagery. These facts suggest that orbitally derived Doppler shift cannot be the dominant imaging mechanism for oceanic waves. (Author)

A81-49777 # **Digital image analysis of SAR imagery for the detection of icebergs.** W. E. Kirby (Intera Environmental Consultants, Ltd., Ottawa, Canada). In: Canadian Symposium on Remote Sensing, 6th, Halifax, Canada, May 21-23, 1980, Proceedings. Ottawa, Canadian Aeronautics and Space Institute, 1981, p. 249-262. 7 refs.

In the spring of 1979, four-channel SAR data sets over iceberg-infested waters were obtained as part of the Sursat program. Portions of this imagery were digitized and analyzed to evaluate the utility of present image processing methods in isolating icebergs and for incorporation into future iceberg prediction models. It is found that: (1) level slicing of the raw data was not suitable for isolating icebergs from the background pack ice, especially in the XHH band; (2) median filtering significantly reduced radar speckle and improved the identification of the icebergs; (3) supervised classification methods resulted in significant data gaps, and were found to be time-consuming; (4) the two-dimensional parallelepiped plots are valuable in assessing the results of the classification procedures; and (5) none of the techniques used could isolate the icebergs from the background pack ice, since the methods function in feature space where the distributions of the spectral intensities determine the classifications. O.C.

A81-49779 # **Optimizing imaging radar parameters for ice reconnaissance.** R. T. Lowry (Intera Environmental Consultants, Ltd., Ottawa, Canada) and H. G. Hengeveld (Department of the Environment, Atmospheric Environment Service, Downsview, Ontario, Canada). In: Canadian Symposium on Remote Sensing, 6th, Halifax, Canada, May 21-23, 1980, Proceedings. Ottawa, Canadian Aeronautics and Space Institute, 1981, p. 273-283. 6 refs.

A81-49805 # **Airborne remote sensing of sea surface chlorophyll and temperature along the outer British Columbia coast.** G. A. Borstad, R. M. Brown (Search Oceanography, Ltd., Sidney, British Columbia, Canada), and J. F. R. Gower (Institute of Ocean Sciences, Sidney, British Columbia, Canada). In: Canadian Symposium on Remote Sensing, 6th, Halifax, Canada, May 21-23, 1980, Proceedings. Ottawa, Canadian Aeronautics and Space Institute, 1981, p. 541-549. 12 refs. Department of Supply and Services Contract No. 1SB-79-00097.

A81-49807 # **Meteosat experience in assisting commercial fishing (Météosat et l'experience d'aide à la pêche).** J.-C. Favard (Centre National d'Etudes Spatiales, Toulouse, France), J.-M. Stretta, and J. Citeaux (Office de la Recherche Scientifique et Technique d'Outre-Mer, Bondy, Seine-Saint-Denis, France). In: Canadian Symposium on Remote Sensing, 6th, Halifax, Canada, May 21-23, 1980, Proceedings. Ottawa, Canadian Aeronautics and Space Institute, 1981, p. 561-565. 5 refs. In French.

A81-49967 * **Regression techniques for oceanographic parameter retrieval using space-borne microwave radiometry.** R. Hofer (Ciba-Geigy AG, Basel, Switzerland) and E. G. Njoku (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA). *IEEE Transactions on Geoscience and Remote Sensing*, vol. GE-19, Oct. 1981, p. 178-189. 18 refs. Research supported by the U.S. National Academy of Sciences; Contract No. NAS7-100.

Variations of conventional multiple regression techniques are applied to the problem of remote sensing of oceanographic parameters from space. The techniques are specifically adapted to the scanning multichannel microwave radiometer (SMRR) launched on the Seasat and Nimbus 7 satellites to determine ocean surface temperature, wind speed, and atmospheric water content. The retrievals are studied primarily from a theoretical viewpoint, to illustrate the retrieval error structure, the relative importances of different radiometer channels, and the tradeoffs between spatial resolution and retrieval accuracy. Comparisons between regressions using simulated and actual SMMR data are discussed; they show similar behavior. (Author)

N81-28668# World Meteorological Organization, Geneva (Switzerland). Commission for Marine Meteorology.
REPORTS ON MARINE SCIENCE AFFAIRS. REPORT 14: SATELLITE DATA REQUIREMENTS FOR MARINE METEOROLOGICAL SERVICES
G. D. Hamilton 1980 53 p refs
(WMO-548; ISBN-92-63-10548-0; Rept-14) Avail: NTIS MF A01; print copy available from WMO, Geneva

The applications of satellite data in marine meteorology are reviewed, and the specific requirements for quantitative data gathered by satellite are discussed. The analysis of satellite derived parameters includes surface winds, sea and swell, surface visibility, ice accretion, precipitation, cloud cover, air temperature, humidity, sea surface temperature, surface currents, atmospheric pressure, surf and breakers, storm surge, and sea ice. The availability and access to satellite data for the various marine user groups is examined. A tabular summary of satellites of utility to marine meteorology, their sensors, and observable parameters is provided. Author (ESA)

N81-30168# British Aerospace Dynamics Group, Bristol (England). Space and Communications Div.
COASTAL OCEANS MONITORING SATELLITE SYSTEM (COMSS) SYSTEM EVALUATION STUDY Final Report
Paris ESA Jan. 1981 131 p refs
(Contract ESA-3632/78/F-CG(SC))
(ESS/SS-1035; ESA-CR(P)-1433) Avail: NTIS HC A07/MF A01

The individual sensors, launcher (Ariane) and platform are defined. Payloads A and B are described with emphasis on an ocean color monitor, imaging microwave radiometer, synthetic aperture radar and supporting units. Orbits and coverage, configuration options, power and mission profile and data handling are detailed. Satisfaction of payload power remains the most severe problem (for the power subsystem parameters considered) for payload A unless the operating duty cycles are restricted which can be accommodated within the ARIANE shroud. Sufficient mass margin (over 100 kg) exists to allow the inclusion of additional small instruments. These have to operate infrequently or at very low average power to avoid further aggravating the power problem. Wideband type tape recorders (around 5-10 GB

capacity) should be carried to provide reasonable orbit cover. For Payload B, the provisional scatterometer parameters (notably power and data) appear to be very demanding. Consequently, the duty cycles of operation of other instruments have to be severely restricted if the scatterometer operates frequently.
Author (ESA)

N81-30498# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
FOLLOWING OCEANOGRAPHIC PHENOMENA ON THE SOUTH COAST OF BRAZIL WITH REMOTE SENSING FROM ORBITAL DISTANCE [ACOMPANHAMENTO DE FENOMENOS OCEANOGRAFICOS DA COSTA SUL DO BRASIL POR SENSORIAMENTO REMOTO A DISTANCIA ORBITAL]
Emmanuel Gama deAlemida and Keiko Tanaka Jan. 1981 35 p refs In PORTUGUESE; ENGLISH summary
(INPE-1975-RPE/280) Copyright. Avail: NTIS HC A03/MF A01

Data obtained by the very high resolution radiometer (VHRR) on the NOAA-5 satellite show thermal contrast due to cold upwelled water which occurs along the coast of Rio de Janeiro State. Coastal station data, VHRR data, and a mathematical model based on Ekman's theory suggest a possible interpretation of mesoscale oceanic phenomena. It is concluded that: (1) when surface winds are from 22.5 deg (true), the thermal VHRR imagery indicates a cool surface plume that extends south of Cabo Frio; (2) when the wind direction increases to 67.5 deg (true) the cool plume changes to a SW direction; and (3) when the wind direction becomes than 135 deg (true), there is no cool water present near the coast. A.R.H.

N81-30765# National Oceanic and Atmospheric Administration, Rockville, Md.
NOAA CLIMATE PROGRAM PLAN
Jan. 1981 57 p refs
(PB81-193815; NOAA-81022305) Avail: NTIS HC A04/MF A01 CSCL 04B

The overall goal of the NOAA Climate Program is to develop and deliver improved climate data, information, and prediction services and to expand understanding of climate processes through focused physical, dynamic, and statistical climate research. Particular emphasis will be directed to studies of the impacts of natural climate variability on commercially important marine fisheries. GRA

N81-30780# National Oceanic and Atmospheric Administration, Rockville, Md. Office of Marine Pollution Assessment.
ENVIRONMENTAL ASSESSMENT OF THE ALASKAN CONTINENTAL SHELF: REPORTS OF PRINCIPAL INVESTIGATORS. VOLUME 1: REACTORS - BIRDS, PLANKTON, LITTORAL, BENTHOS Annual Reports
1980 815 p refs Sponsored in part by Bureau of Land Management 3 Vol.
(PB81-196263) Avail: NTIS HC A99/MF A01 CSCL 08A

Simulation modeling of marine bird population energetics, food consumption, and sensitivity to perturbation was performed. Shorebird dependence on Arctic littoral habitats was studied as well as the distribution, abundance, and feeding ecology of birds associated with pack ice. A study of the population numbers and productivity of colonial seabirds is included. Plankton studies in the Bering Sea and an environmental assessment of selected habitats in the Arctic littoral system are also included. The distribution, abundance, community structure, and trophic relationships of the benthos of the Northeastern Gulf of Alaskan from Yakutat Bay to Cross Sound and the distribution, abundance, diversity, and productivity of the Western Sea benthos were studied. E.D.K.

N81-31605*# GeoScience Research Corp., Salisbury, Md.
ICE SHEET ALTIMETRY Final Report
R. L. Brooks Mar. 1981 32 p refs
(Contract NAS6-3117)
(NASA-CR-156877) Avail: NTIS HC A04/MF A01 CSCL 14B

Generalized surface slopes were computed for the Antarctic and Greenland ice sheets by differencing plotted contour levels and dividing them by the distance between the contours. It was observed that more than 90% of the ice sheets have surface slopes less than 1%. Seasat test mode-1 Seasat altimeter measurements over Greenland were analyzed by comparisons with collinear and intersecting normal mode Seasat altimeter passes. Over the ice sheet, the computed surface elevations from test mode-1 measurements were consistently lower by about 45 m and the AGC levels were down by approximately 6 dB. No test mode-1 data were acquired over Antarctica. It is concluded that analysis of the existing altimeter data base over the two ice sheets is crucial in designing a future improved altimeter tracking capability. It is recommended that additional waveform retracking be performed to characterize ice sheet topography as a function of geographic area and elevation. A.R.H.

N81-31803# Defense Mapping Agency Hydrographic and Topographic Center, Washington, D.C.
INTERPRETATION OF HYDROGRAPHIC FEATURES SEEN IN THE WATERS OFF CAPE COD Final Report. M.S. Thesis
Charles Leonard Reed May 1981 193 p refs
(AD-A102343) Avail: NTIS HC A09/MF A01 CSCL 08/10

A study was conducted to determine the origin of features appearing in a LANDSAT image (1724-14472; 17 July 1974) of the waters off Cape Cod by multitemporal and multispectral analysis techniques. Acquisition of ancillary data supplemented imagery from five different sensors, including visible, near infrared, and microwave, representing fifteen discrete times over a five-year period. Digital data for the LANDSAT image was evaluated multispectrally. Various water reflectance models were applied to the digital data to determine whether features related to reflected light from the ocean bottom, turbidity, or surface reflectance. Parameters were estimated from historical data. Results of model calculations were compared with the observed radiances at several locations in the scene. Multitemporal analysis affirmed that the following detailed information can be determined from space imagery: Rapid rates of coastal change, possible uncharted shoals, and theorized surface manifestations of internal waves. In all cases multisensor imagery increased the reliability of the derived information. Multispectral analysis provided additional evidence for attributing variations of reflectance in deep ocean to the effects of surface reflection and also appears to be the primary cause of reflectivity of patterns over the shoal areas around Nantucket Island. Author (GRA)

N81-31807# National Oceanic and Atmospheric Administration, Miami, Fla. Atlantic Oceanographic and Meteorological Labs.
DRIFTING BUOY DATA FROM THE TROPICAL PACIFIC OCEAN DURING NORPAX EQUATORIAL TEST SHUTTLE EXPERIMENT
Donald V. Hansen, Carol C. Duckett, William Patzert, Gerald McNalley, and Edmund Kerut Sep. 1980 79 p
(Grant NSF OCE-16827)
(PB81-198939; NOAA-TM-ERL-AOML-45; NOAA-81031705) Avail: NTIS HC A05/MF A01 CSCL 08C

The core project of the Test Shuttle experiment was serial CTD and XBT sampling between 20 degrees N and 17 degrees S along 150 degrees W at approximately monthly intervals and weekly AXBT sampling on 150 degrees W and 158 degrees W. These observations were collected between Hawaii and Tahiti, spanning the North Equatorial Current (NEC), the North Equatorial Counter Current (NECC) and the South Equatorial Current (SEC). GRA

N81-31808# National Advisory Committee on Oceans and Atmosphere, Washington, D.C. Task Group on Services to Ocean Operations.
OCEAN SERVICES FOR THE NATION. NATIONAL OCEAN GOALS AND OBJECTIVES FOR THE 1980'S
Victoria J. Jones, ed. Jan. 1981 82 p
(PB81-200602; NACOA-18) Avail: NTIS HC A05/MF A01 CSCL 03J

The goals include: ocean observation and prediction; navigation and positioning, mapping and charting; ocean data and information dissemination; monitoring the ocean; and a new ocean measurement capability. These goals are to provide improved Arctic and Antarctic Ocean information. GRA

N81-33342# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany).
IMAGING RADAR SYSTEMS
F. Schlude *In* ESA Coherent and Incoherent Radar Scattering from Rough Surfaces and Vegetated Areas May 1981 p 29-39 refs

Avail: NTIS HC A08/MF A01

Imaging systems are classified and described. A description of design procedure and problems is provided. Factors affecting image quality of thin point target distributions are analyzed and limitations of this model are pointed out. The imaging of quasi-continuous point distributions and its application to ocean surface imaging are considered. A comparison is made of systems combining imaging and Fourier transformation used in oceanographic research. The technical data of various systems is summarized. Author (ESA)

N81-33344# Kansas Univ. Center for Research, Inc., Lawrence. Remote Sensing Lab.

SEA SURFACE SCATTERING

Richard K. Moore *In* ESA Coherent and Incoherent Radar Scattering from Rough Surfaces and Vegetated Areas May 1981 p 53-61 refs

Avail: NTIS HC A08/MF A01

Basic mechanisms of sea-surface scattering are described for a two-scale model. The basic concept of Bragg resonance is illustrated with a sinusoidal component of the ocean spectrum. *Factors affecting the overall spectrum of ocean waves are listed.* Sketches show the geometry associated with using a scatterometer to calculate windspeed in measurements of radar backscatter from the wind driven sea. The model described is quasi-empirical based upon theoretical calculations and measurements with both spacecraft and aircraft. Problems in accurate determination of model parameters are discussed for aircraft and spacecraft. Details are given of research on capillary wave distribution, the satellite altimeter and other non-imaging techniques for determining wave spectra are set out. Unknown quantities including surface expression of bottom topography are mentioned. Author (ESA)

N81-33539*# Environmental Research and Technology, Inc., Concord, Mass.

COMPARATIVE ANALYSIS OF SEA ICE FEATURES USING SIDE-LOOKING AIRBORNE RADAR (SLAR) AND LANDSAT IMAGERY Final Report

James C. Barnes and Clinton J. Bowley, Principal Investigators Cleveland NASA. Lewis Research Center Mar. 1981 71 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S.D. 57198. ERTS

(Contract NAS3-21924)

(E81-10044; NASA-CR-165335; P-3970-F) Avail: NTIS HC A04/MF A01 CSCL 08L

A comparative analysis of sea ice features was carried out using X-Band, real aperture side-looking airborne radar (SLAR) and LANDSAT imagery. The SLAR data were collected by the NASA/LeRC C-131 aircraft on flights over the Mackenzie Delta and Prudhoe-Barrow areas of the southern Beaufort Sea and the Norton Sound area of the eastern Bering Sea. The LANDSAT data were for dates as near as possible to the dates of the SLAR missions. The analysis of the data sample available for the investigation indicates the SLAR imagery has distinct advantages over LANDSAT for identifying certain features and ice types. It is further indicated that the capability for SLAR observe ice through clouds is essential for an operational ice information system. R.C.T.

N81-33763# Defense Mapping Agency Hydrographic and Topographic Center, Washington, D.C. Hydrographic/Topographic Center.

DERIVATION OF SHALLOW OCEAN BOTTOM REFLECTANCE VALUES FROM COLOR AERIAL PHOTOGRAPHY

Donald J. Gerson, Lynn K. Fehrenbach, Kenneth R. Piech, and David W. Gaucher Jun. 1981 22 p refs

(AD-A101105) Avail: NTIS HC A02/MF A01 CSCL 08/10

An alternative to the field survey method of acquiring hydrographic data is described. The technique involves the use of digitized color aerial photography in the derivation of the percentage of reflectance of shallow ocean bottom materials. These spectral reflectance values can then be used in an algorithm for calculating water depths. The reflectances that were derived in this study show a close relative comparison to ground truth information. After a discussion of the causes of discrepancies between derived and actual reflectance values, it is concluded that this method of data acquisition merits further investigation due to its high geometric fidelity, its simplicity, and its cost and *time saving benefits.* Author (GRA)

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HYDROLOGY AND WATER MANAGEMENT

Includes snow cover and water runoff in rivers and glaciers, saline intrusion, drainage analysis, geomorphology of river basins, land uses, and estuarine studies.

A81-41158 # **Determination of moisture from NOAA polar orbiting satellite sounding radiances.** C. M. Hayden, W. L. Smith, and H. M. Woolf (NOAA, National Earth Satellite Service, Madison, WI). *Journal of Applied Meteorology*, vol. 20, Apr. 1981, p. 450-466. 11 refs.

A method is analyzed by which lower troposphere moisture fields can be deduced from radiances measured by satellite. A retrieval technique is described, and the method is evaluated statistically using both synthesized radiances and actual satellite measurements. The TIROS operational vertical sounder (TOVS) measurements made in the 6.7 micron water vapor absorption band are investigated. Three major changes to current operational methods are reported: (1) the surface contribution to the outgoing radiance is subtracted before making temperature and moisture retrievals, allowing a better definition of low-level moisture gradients. (2) The temperature/moisture solution is subjected to a one channel iteration to ensure that the radiative transfer equation is satisfied for low-level moisture, which is beneficial in cases of extreme dryness. (3) In areas of extensive cloud cover, a cloud moisture model is introduced to allow a definition of the atmospheric moisture below the cloud. It was found that the moisture in the surface -700 mb and 850-500 mb layers and particularly the horizontal gradient pattern can be well defined. E.B.

A81-41723 # **The use of satellite data in predicting spring flow in the basins of the upper Ob' and upper Enisei (Opyt primeneniia kosmicheskoi informatsii dlia tselei prognoza vesennego stoka v basseinakh rek verkhnei Obi i verkhnego Eniseia).** N. V. Vostriakova. In: Problems of the utilization and protection of the natural resources of Siberia (Problemy ispol'zovaniia i okhrany prirodnykh resursov Sibiri). Novosibirsk, Izdatel'stvo Nauka, 1980, p. 26-30. 7 refs. In Russian.

A81-42095 **Insights into errors of SMS-inferred GATE convective rainfall.** J. A. Augustine, C. G. Griffith, W. L. Woodley (NOAA, Office of Weather Research and Modification, Boulder, CO), and J. G. Meitin (Cooperative Institute for Research in Environmental Sciences, Boulder, CO). *Journal of Applied Meteorology*, vol. 20, May 1981, p. 509-520. 7 refs. NOAA-supported research.

It is noted that, in the mean, the Griffith/Woodley rain estimation technique underestimated the radar-measured rain of each of the three phases of GATE, to varying degrees, and that the satellite-derived rain at the isohyets were generally too extensive relative to radar-measured patterns. Three possible error sources are investigated. They are: (1) the method of apportionment of satellite-derived rain at the surface; (2) resolution degradation of the digital satellite imagery; and (3) anomalous behavior of convective clouds in the tropical Atlantic relative to those of the Florida derivation data set. To correct the satellite-derived rain patterns, a new method of apportionment is tested by recomputing the GATE satellite rain estimates. The relative error caused by resolution degradation is quantified by comparing rain estimates produced from full resolution imagery to estimates derived from degraded imagery for an 8 deg latitude by 12 deg longitude area in the eastern tropical Pacific ocean over a 54 h period. The remaining differences between the GATE satellite and radar estimates are considered to be attributable to different conditions prevailing in Florida and in GATE. C.R.

A81-42126 **Satellite detection of seiches in Great Salt Lake, Utah.** M. Matson and C. P. Berg (NOAA, National Earth Satellite Service, Washington, DC). *Water Resources Bulletin*, vol. 17, Feb. 1981, p. 122-128. 21 refs.

On June 15, 1977, an unusual brightness anomaly was detected in the north arm of Great Salt Lake, Utah, on NOAA-5 Very High Resolution Radiometer (VHRR) visible band imagery and on Landsat-2 multispectral visual band imagery. Retrospective inspection of NOAA-3, 4, and 5 satellite imagery from 1974-77 revealed 12 previous cases of the anomaly, whereas post monitoring documented nine other cases through May 1978. Comparison of lake levels in the north arm with meteorological parameters leads to the conclusion that the anomalous brightness is associated with wind induced seiches in the north arm. Apparently the wind induces a lower water depth, turbulence, and mixing throughout the water column in the western third of the north arm, thus increasing the brightness of the surface waters chiefly from sediment resuspension. (Author)

A81-42229 * **Simulation modeling of estuarine ecosystems.** R. W. Johnson (NASA, Langley Research Center, Hampton, VA). In: Estuarine and wetland processes. New York, Plenum Publishing Corp., 1980, p. 541-559. 18 refs.

A simulation model has been developed of Galveston Bay, Texas ecosystem. Secondary productivity measured by harvestable species (such as shrimp and fish) is evaluated in terms of man-related and controllable factors, such as quantity and quality of inlet fresh-water and pollutants. This simulation model used information from an existing physical parameters model as well as pertinent biological measurements obtained by conventional sampling techniques. Predicted results from the model compared favorably with those from comparable investigations. In addition, this paper will discuss remotely sensed and conventional measurements in the framework of prospective models that may be used to study estuarine processes and ecosystem productivity. (Author)

A81-43176 **Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979.** Symposium sponsored by the American Water Resources Association. Edited by M. Deutsch (U.S. Geological Survey, Reston, VA), D. R. Wiesnet (NOAA, Washington, DC), and A. Rango (NASA, Goddard Space Flight Center, Greenbelt, MD). Minneapolis, MN, American Water Resources Association, 1981. 743 p. $85.

Philosophical and technical backgrounds for the application of remote sensing by earth scientists are presented. Interests and activities of participating agencies of the United States and Canadian governments, universities, and the private sector in implementing satellite technology in a diverse array of water-related programs are described. Consideration is then given to applications of satellite data to the various aspects of the hydrologic cycle and man's impact on it: meteorology, snow and ice, surface water, soil moisture, ground water, wetlands, coastal zone, water quality and environment, and water use and management. B.J.

A81-43177 **Remote sensing in hydrology - A challenge to scientists.** J. S. Cragwall, Jr. (U.S. Geological Survey, Reston, VA). In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979. Minneapolis, MN, American Water Resources Association, 1981, p. 3-5.

Hydrologic applications of remote sensing by satellites are briefly reviewed. Specific applications discussed include: shallow ground water exploration, inventorying of surface waters, estimation of water withdrawal and consumption, assessment of sea and polar ice conditions, and the relay of hydrologic data to collecting points by satellites. Some of the problems yet to be solved are: better resolution in the thermal infrared and microwave parts of the spectrum, a quick-look capability that can be used for planning purposes, and an improved ability to incorporate land surface features into hydrologic models, which means solving the associated problems of large-scale data storage and processing. V.L.

A81-43178 **Satellite applications in river and flood forecasting.** R. A. Clark (NOAA, National Weather Service, Silver Spring, MD). In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979. Minneapolis, MN, American Water Resources Association, 1981, p. 6-8.

Several applications of satellites to river and flood forecasting

are described. Areas in which satellites offer a great potential for improved forecasts include areal estimates of snow cover, data relay, improved rainfall estimates in data sparse regions, and better definition of areal variation of soil moisture. (Author)

A81-43179 * NASA water resources/hydrology remote sensing program in the 1980's. M. A. Calabrese and P. G. Thome (NASA, Washington, DC). In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979. Minneapolis, MN, American Water Resources Association, 1981, p. 9-15. 19 refs.

A81-43180 Corps of Engineers utilization of satellites for hydrologic purposes. V. K. Hagen (U.S. Army, Corps of Engineers, Washington, DC). In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979. Minneapolis, MN, American Water Resources Association, 1981, p. 16-18.

Activities of the U.S. Army Corps of Engineers in the application of satellites to hydrologic studies are reviewed starting with its initial experiment in 1972. Specific applications discussed include: water control management, runoff estimation, land use, monitoring changes, flooded area identification, and location of important features such as dams and lakes. Most of the current research relates to improved sensors or advanced applications of satellite imagery. V.L.

A81-43182 A review of Canada's present and future remote sensing activities relating to hydrology. E. J. Langham (National Hydrology Research Institute, Ottawa, Canada). In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979. Minneapolis, MN, American Water Resources Association, 1981, p. 26-32. 12 refs.

The presentation reviews the technical resources in Canada for acquisition and processing remotely sensed data with particular attention to airborne and satellite borne instrumentation, satellite data reception, and data analysis systems used by various agencies. It then goes on to give examples of applications of these data from various subdisciplines of hydrology. (Author)

A81-43183 Satellite versus conventional methods in hydrology. D. G. Anderson (U.S. Geological Survey, Reston, VA). In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979. Minneapolis, MN, American Water Resources Association, 1981, p. 33-36. 21 refs.

Remote sensing applications research efforts are discussed under three broad categories: (1) replace conventional methods with satellite based approaches; (2) combine conventional and satellite data; and (3) emphasize problems unique to solution by the use of satellite data. It is pointed out that most applications of satellite data in each of the three categories require a combination of field observations and related experience for reasonable analysis. Satellite and conventional data tend to be complementary and techniques using both types of data should be considered in hydrologic studies. V.L.

A81-43184 An introduction to satellite hydrology. G. K. Moore (U.S. Geological Survey, EROS Data Center, Sioux Falls, SD). In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979. Minneapolis, MN, American Water Resources Association, 1981, p. 37-41. 5 refs.

A81-43186 Adapting GOES DCS for use by Corps of Engineers. T. D. Buckelew (U.S. Army, Corps of Engineers, Waltham, MA). In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979. Minneapolis, MN, American Water Resources Association, 1981, p. 48-50.

New England Division, Corps of Engineers, working with private industry, has demonstrated a random reporting capability for collecting data using a standard 1500 Hz channel on NOAA's Geostationary Environmental Operational Satellite (GOES). In the random reporting system, hundreds of data collection platforms (DCP's) transmit on a single channel at proper time intervals to ensure an acceptable probability of reception. Several techniques have been incorporated to improve reception probabilities, the main ones being a short message (less than 3 seconds) and an adaptive algorithm programmed into each platform. This algorithm assures sufficient transmission during critical times, yet relieves the system of superfluous messages during normal periods when no new or important information has been generated. The demonstration has confirmed that, even without the adaptive feature, at least 200 platforms will report successfully (with 90 percent probability) within an hour. (Author)

A81-43187 Satellite telemetry of hydrologic data in California. C. A. McCullough (California, Dept. of Water Resources, Div. of Flood Management, Sacramento, CA). In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979. Minneapolis, MN, American Water Resources Association, 1981, p. 51-53.

Telemetry of hydrologic data in California is beginning to use a satellite as part of the communication path. At present a snow water content sensor and ten precipitation gages report through a satellite. In addition, fire weather data passes through the satellite to aid in suppression of forest and range fires. Large amounts of real-time data are essential to water management and include stream flow, precipitation, wind, snow water content, temperature water quality, and reservoir stage. The present system collects data from about 180 locations, part of which are tied into a computer. Eventually it will process all the data. The emphasis is on real-time data for flood forecasting, water supply forecasting, and water operations. Use of satellites eliminates radio rath problems in mountain terrain and decreases use of mountaintop repeaters that are subject to climatic problems. Changes in the satellite facilities available to us are needed to achieve real-time data acquisition capability. (Author)

A81-43188 Monitoring Canada's water resources in remote regions by satellite telemetry. I. A. Reid (Environment Canada, Environmental Management Service, Ottawa, Canada), C. Pesant (Quebec, Ministère des Richesses Naturelles, Direction Générale des Eaux, Quebec, Canada), and B. E. Goodison (Environment Canada, Atmospheric Environment Service, Downsview, Ontario, Canada). In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979. Minneapolis, MN, American Water Resources Association, 1981, p. 54-59. 17 refs.

Since 1894 much activity has taken place with respect to monitoring, cataloguing, and managing Canada's inland waters. In 1979, the formal active network of the Water Survey of Canada consists of 2749 stations across Canada. Agencies at both the federal and provincial levels and some publicly owned companies are endeavoring to employ the advantages of telemetry by satellites. The Atmospheric Environment Service (AES) of Environment Canada is becoming actively involved in satellite telemetry to provide better service to the Canadian public. Currently, some 300 meterological and climatological stations provide real-time weather observations during all or part of the day utilizing human resources. Satellite telemetry would provide a less expensive yet reliable means of getting the necessary observations from remote areas. Environmental Management Service (EMS), also part of Environment Canada, joined NASA in an experiment to retransmit hydrometric data by satellite with the launch of Landsat in 1972. At present EMS has 40 Data Collection Platforms deployed across Canada. G.R.

A81-43191 A satellite derived technique for estimating rainfall from thunderstorms and hurricanes. R. A. Scofield and V. J. Oliver (NOAA, National Environmental Satellite Service, Washington, DC). In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979. Minneapolis, MN, American Water Resources Association, 1981, p. 70-76. 7 refs.

The purpose of this paper is threefold: (1) to summarize the Scofield/Oliver technique for making rainfall estimates from convective systems, (2) to present the results using the technique in real time on major flash flood producing thunderstorms in Mississippi (April 1979) and on Hurricane Anita (September 1977) as the storm advanced into northeastern Mexico, and (3) to discuss some possible

reasons why the technique often underestimates the copious rainfall associated with the slow moving remnants of tropical storms. The flash flood producing thunderstorms occurred in Mississippi on April 11-13, 1979. Results showed that the 48-hour estimated heavy rainfall pattern was quite similar to the observed. As Hurricane Anita approached the coastal area, the San Antonio Weather Service Forecast Office (WSFO) was concerned with potential flooding in the Rio Grande basin and in Brownsville, Texas. During the critical time period from September 1-2, 1977, rainfall estimates were provided to the San Antonio WSFO. The results indicated that the rainfall estimates from Hurricane Anita were quite comparable with the ground truth rain gauge measurements. (Author)

A81-43192 Utilizing GOES imagery to determine convective storm characteristics in data deficient regions. J. P. Jolly (J. P. Jolly and Associates, Ottawa, Canada). In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979. Minneapolis, MN, American Water Resources Association, 1981, p. 77-83.

In many developing countries there is a scarcity of continuous recording precipitation gauges. This hinders or prevents hydrologic analyses for small or medium-sized basins. Using GOES-obtained enhanced infrared imagery and a recently developed technique, which related heights and expansion/contraction characteristics of cumulonimbus clouds to one-half hour rainfall amounts, convective storms were analyzed. The relations between cloud brightness levels on enhanced infrared imageries and one-half hour rainfall amounts were verified using regional recorded daily rainfall totals from which particular storm rainfall characteristics were estimated. (Author)

A81-43193 Rain estimation over several areas of the globe using satellite imagery. W. L. Woodley, C. G. Griffith (NOAA, National Hurricane and Experimental Meteorology Laboratory, Coral Gables, FL), and J. A. Augustine (NOAA, Weather Modification Program Office, Boulder, CO). In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979.

Minneapolis, MN, American Water Resources Association, 1981, p. 84-91. 7 refs. NOAA-supported research; U.S. Bureau of Reclamation Contract No. 8-07-83-V0016.

A computer-automated technique to estimate rainfall using digital, infrared geosynchronous satellite imagery has been developed and tested. The method requires time histories of convective entities at discrete temperature thresholds and a set of empirical relationships. Development of tracking software and access to a large computer now permit rain estimates for large (10-million sq km) areas down to individual clouds. Rain estimates for several areas of the globe (Florida, the tropical Atlantic Ocean and western Africa, the eastern tropical Pacific Ocean and tropical South America, two flash flood situations, and the U.S. High Plains) are presented. The satellite-inferred rainfalls are compared to ground truth when available. (Author)

A81-43197 * Modeling the terrestrial hydrology for the global atmosphere - The future role of satellite data. J. D. Lin, P. Bock, and J. J. Alfano (Connecticut, University, Storrs, CT). In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979. Minneapolis, MN, American Water Resources Association, 1981, p. 124-138. 14 refs. Grant No. NsG-5075.

A global terrestrial hydrology model has been developed for the transport and storage of moisture and heat in the ground surface layer where the hydrological parameters react to diurnal and seasonal changes in the atmosphere. The spatial and temporal variability of land surface features is considered in the model by means of large scale parameterizations. The model can be either forced by the atmosphere using conventional meteorological data or coupled to an atmospheric general circulation model (GCM) for interactive studies. The global surface is divided into 4 deg longitude by 5 deg latitude cells while the ground is represented by a thin surface layer, a bulk layer (the root zone), and a deep layer (the ground water zone). Results are presented from a seven-day global experiment which was conducted utilizing the GLAS GCM (NASA Goddard Laboratory for Atmospheric Sciences). The model has demonstrated its capability to predict, over a large region, the overall soil moisture storage and major flux exchanges with the atmosphere above and the ground water below. (Author)

A81-43198 A statistical approach to rainfall estimation using satellite data. L. F. Whitney, Jr. and L. D. Herman (NOAA, National Environmental Satellite Service, Washington, DC). In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979. Minneapolis, MN, American Water Resources Association, 1981, p. 139-143. 6 refs.

A statistical approach is used in an attempt to estimate convective rainfall using satellite data. The objective is to furnish rainfall estimates in a form suitable as input to hydrologic models which forecast river flow. These models require area-averaged rainfall over periods of 6 hours in watersheds covering 500 or more square miles. It is noted that from among the variables used, a screening regression method selected those which best explain area-averaged rainfall. In both cases studied, the selected variables correlate with rainfall at above 0.8. However, since meteorological conditions in each case were very different, neither regression equation was a good estimator of the rainfall in the other case. Some of the most important variables selected are IR-temperature gradients along the tropospheric shear, ratio of IR-temperature to IR-temperature gradient along the low-level wind, low-level dewpoint, low-level dewpoint gradient along the high-level wind, and low-level dewpoint advection. It is noted that although these preliminary results are encouraging, many more cases must be included and any positive results checked against independent data. C.R.

A81-43199 Roles of satellites in hydrology. D. G. Anderson (U.S. Geological Survey, Reston, VA). In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979. Minneapolis, MN, American Water Resources Association, 1981, p. 144-155. 26 refs.

The usefulness of satellite data in hydrologic applications is demonstrated by examples involving three areas (Arctic region; Ouachita River, Arkansas/Louisiana; and Albemarle-Pamlico Sounds, North Carolina). The data used included data from four satellite systems (Apollo, Landsat, Nimbus, and Heat Capacity Mapping Mission), covering the visible, thermal, and infrared bands and ranging in resolution from 30 m to 50 km. It is shown that data from satellites, if analyzed at the initial stage of a hydrologic study, can provide valuable conceptual information on the hydrologic systems involved. V.L.

A81-43200 Satellite snow mapping techniques with emphasis on the use of Landsat. C. J. Bowley and J. C. Barnes (Environmental Research and Technology, Inc., Concord, MA). In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979. Minneapolis, MN, American Water Resources Association, 1981, p. 158-164. 18 refs.

The types of satellite data that have been used to map snow cover and the interpretative techniques that have evolved are reviewed with emphasis on the application of snow covered areas from Landsat to runoff prediction. It is pointed out that the experience of the data interpreter is highly valuable in estimating snow covered area during partial cloud cover conditions, and when interpreting snow cover in areas of heavy forest cover, mountain shadows, and bare rock terrain. The application of remote sensing in portions of the spectrum other than the visible is also discussed. V.L.

A81-43201 Application of snow covered area to runoff forecasting, in the Sierra Nevada, California. J. F. Hamnaford and A. J. Brown (California, Dept. of Water Resources, Snow Surveys Branch, Sacramento, CA). In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979, Minneapolis, MN, American Water Resources Association, 1981, p. 165-172.

Results of a four-year project to explore the application of snow covered area (SCA) obtained from satellite imagery to hydrologic forecasting are summarized. Data describing SCA are found to have greatest hydrologic application during the period of snow melt in the

spring and early summer rather than during the period of snow pack accumulation. SCA provides the source of near real-time data from within the watershed during a period when snow pack conditions are changing rapidly and snow melt runoff rates are high. SCA data may be most useful for detection and monitoring of conditions within the basin that depart from natural or experienced conditions. V.L.

A81-43202 Satellite Image Atlas of the earth's glaciers. R. S. Williams, Jr. and J. G. Ferrigno (U.S. Geological Survey, Reston, VA). In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979. Minneapolis, MN, American Water Resources Association, 1981, p. 173-182. 24 refs.

In June 1977, a project was initiated to prepare a 'Satellite Image Atlas of Glaciers'. It is pointed out that there exist sufficient Landsat, NOAA, and other satellite data in various archives for this project. The preparation of such an atlas is considered a timely effort because of the wide variety of impending and ongoing U.S. and international climatological studies. The primary objective of the atlas is to provide a pictorial inventory either in the form of a Landsat or other satellite image, or as a tabular listing of the best available Landsat or other satellite images of extant glaciers. Such an atlas should provide a means of obtaining a better estimate of the total area of the planet covered by glaciers. Attention is given to image selection, the contents of the atlas, the Antarctic ice sheet, Iceland, and Svalbard. G.R.

A81-43203 The satellite record of the winter of 1978-79 in North America. D. R. Wiesnet and C. P. Berg (NOAA, National Environmental Satellite Service, Washington, DC). In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979. Minneapolis, MN, American Water Resources Association, 1981, p. 183-187. 9 refs.

The satellite record of the winter 1978-79 is reviewed to demonstrate the utility of NOAA/NESS (National Oceanic and Atmospheric Administration/National Environment Satellite Service) satellite data to record snow cover on a continental basis, which is a good measure of winter's severity. Results examined in the light of a 13-year record show a clear trend toward increased winter snow cover. It is also shown that the severity of the 1978-79 North American winter, as measured by satellite-determined snow cover, was a regional rather than a hemispheric or global phenomenon. V.L.

A81-43204 Potentials of mapping buried glacier ice with Landsat thermal imagery. R. Lougeay (New York, State University, Geneseo, NY). In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979. Minneapolis, MN, American Water Resources Association, 1981, p. 189-192. 5 refs. Research supported by the State University of New York Research Foundation.

Field observations and the analysis of Landsat imagery of the Wrangell Mountains of Alaska provide information on the nature and extent of buried glacier ice. Spectral bands 5, 7, and false color composite imagery from existing Landsat multispectral data proved most useful for mapping glacial margins and large masses of active but buried glacier ice. Signal contrasts between bare detritus and vegetation cover were most strongly pronounced on band 5, while band 7 displayed stronger contrasts between the microtopographic texture of the moraine covered ice masses and adjacent etrital surfaces of talus or outwash. When the mantle of morainic detritus is thinner than the diurnal thermal damping depths, strong signal contrasts between ice cored moraines and dry glacial drift deposits are present. B.J.

A81-43205 Prediction of water yield using satellite imagery and a snowmelt simulation model. W. O. Rasmussen and P. F. Ffolliott (Arizona, University, Tucson, AZ). In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979. Minneapolis, MN, American Water Resources Association, 1981, p. 193-196. 14 refs.

A computer simulation model has been developed for estimating the impacts of alternate land management activities on winter water yield in snow covered areas. The model uses satellite imagery to delineate the areal extent of the snow covered area near peak snow-pack accumulation. A degree-day snowmelt technique is used to predict daily melt, with daily stream flow being computed from recession analysis. The model has been structured in an interactive format to facilitate operation by users at remote locations using readily available data sets. (Author)

A81-43207 * Passive microwave sensing of snow characteristics over land. A. T. C. Chang, D. K. Hall, J. L. Foster, A. Rango, and J. C. Shiue (NASA, Goddard Space Flight Center, Application Directorate, Greenbelt, MD). In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979. Minneapolis, MN, American Water Resources Association, 1981, p. 213-217. 11 refs.

Truck-mounted, airborne, and spaceborne systems with various radiometers ranging in wavelength from 0.8 to 21 cm were used to measure the brightness temperatures of snow-covered areas at test sites near Steamboat Springs and Walden, Colorado. The brightness temperature at a short wavelength (0.8 cm) was found to decrease more rapidly with increasing snow depth than the brightness temperature at a longer wavelength (6 cm). More scattering of the shorter-wavelength radiation by the snow crystals results in a lower brightness temperature. The longer-wavelength (6 cm) radiation penetrates through meters of dry snowpack and is useful for the assessment of the underlying ground conditions. B.J.

A81-43208 Landsat derived snow cover as an input variable for snow melt runoff forecasting in South Central Colorado. B. A. Shafer (Soil Conservation Service, Denver, CO), J. K. Marron (Soil Conservation Service, Arvada, CO), and C. F. Leaf. In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979. Minneapolis, MN, American Water Resources Association, 1981, p. 218-224. 5 refs.

Landsat imagery for the period 1973-78 was used to calculate snow covered area on six drainages in South Central Colorado. Snow covered area was used as a predictor variable to forecast both short-term and seasonal snow melt runoff volumes. The Leaf-Brink Subalpine Water Balance simulation model was adapted to use snow covered area as an input parameter to predict residual volume runoff. Areal snow cover was also used in a statistical model to forecast runoff and is compared to current water equivalent index methods of forecasting. Results indicate that Landsat derived snow cover is highly correlated with seasonal stream flow volumes. Snow cover extent is an important variable for forecast purposes once the main snow melt season begins but is of limited value before that time. (Author)

A81-43209 * Monitoring snow with microwaves. W. H. Stiles and F. T. Ulaby (University of Kansas Center for Research, Inc., Lawrence, KS). In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979. Minneapolis, MN, American Water Resources Association, 1981, p. 225-229. Contract No. NAS5-23777.

Results of an experimental study concerned with the active and passive microwave response to snow pack are discussed. Comprehensive ground truth measurements and preliminary investigations indicate that the primary factors affecting the microwave response are snow water equivalent and snow wetness. The most important conclusion of the study is that the scattering and emission behavior of snow varies drastically as a function of frequency between 1 GHz and 37 GHz, which suggests that the multifrequency operation has the potential to provide estimates on several snow parameters, primarily wetness profile and water equivalent, simultaneously. V.L.

A81-43210 Operational use of satellite data for snow inventory and runoff forecast. G. Ostrem, T. Andersen (Norges Vassdrags- og Elektrisitetsvesen, Oslo, Norway), and H. Odegaard (IBM Norway, Oslo, Norway). In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979. Minneapolis, MN, American Water Resources Association, 1981, p. 230-234. 8 refs. Research supported by the Norges Vassdrags- og

Elektrisitetsvesen and Norges Teknisk-Naturvitenskapelige Forskningsrad.

A method has been developed whereby NOAA and TIROS data are used to evaluate remaining snow in mountain watersheds and to predict the corresponding melt water volume. The method can only be used in vegetation free or almost vegetation free high mountain basins and only during the snow melt period after some 20% of the landscape has become snow free. The relation between the remaining snow cover (as expressed in per cent or in square km) and the subsequent melt water inflow is determined empirically. The method has been used for monitoring water reservoirs in southern Norway but can be also used in other areas. V.L.

A81-43211 * The use of radar imagery for surface water investigations. M. L. Bryan (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA). In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979. Minneapolis, MN, American Water Resources Association, 1981, p. 238-251. 28 refs. Contract No. NAS7-100.

The paper is concerned with the interpretation of hydrologic features using L-band (HH) imagery collected by aircraft and Seasat systems. Areas of research needed to more precisely define the accuracy and repeatability of measurements related to the conditions of surfaces and boundaries of fresh water bodies are identified. These include: the definition of shoreline, the nature of variations in surface roughness across a water body and along streams and lake shores, and the separation of ambiguous conditions which appear similar to lakes. V.L.

A81-43212 An examination of fluvial morphological characteristics of western Amazon streams from Apollo-Soyuz photographs. R. K. Holz and V. R. Baker (Texas, University, Austin, TX). In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979. Minneapolis, MN, American Water Resources Association, 1981, p. 252-259. 9 refs.

Empirical formulas are tested in estimating the hydrologic properties of certain South American rivers. The study reveals the lack of precise understanding of regime behavior in tropical streams and the difficulty of transferring the results of research on humid midlatitude and semiarid midlatitude streams to those of the humid tropical areas. The results show that the low sinuosity Amazon Basin streams transport much finer sediment than do streams of equivalent sinuosity previously described for semiarid regions. Many of the fluvial complexities of the western Amazon Basin are seen as resulting from the relative abilities of different rivers to rework coarse, relict alluvium that was deposited during the relatively arid full-glacial phases of the Pleistocene. C.R.

A81-43213 Hydrologic land use classification using Landsat. R. J. Cermak, A. Feldman, and R. P. Webb (U.S. Army, Hydrologic Engineering Center, Davis, CA). In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979. Minneapolis, MN, American Water Resources Association, 1981, p. 262-269. 8 refs.

Experience with land use classification from Landsat multispectral imagery is described. Land use is required for the estimation of hydrologic model parameters. The land use classification procedure used is an unsupervised, noninteractive approach requiring no special image processing equipment. Watershed land use was determined from Landsat digital data, entered into a geographic data bank, and compared with a conventional land use classification. Hydrologic simulation model parameters were estimated from land use and other basin characteristics. The generated discharge frequency curves, corresponding to the alternative land use classifications, permitted the hydrologic significance of accuracy in land use identification to be assessed. (Author)

A81-43214 Landsat data for regulatory permit monitoring. A. N. Williamson (U.S. Army, Engineer Waterways Experiment Station, Vicksburg, MS). In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979.
Minneapolis, MN, American Water Resources Association, 1981, p. 270-277.

The U.S. Army Corps of Engineers Regulatory Permit Program for activities in navigable inland or ocean waters was revised in July 1975. The major impact of the revisions is the requirement for a Department of the Army permit for the water disposal of dredged or fill material in virtually every water body in the U.S. The immensity of these requirements dictated that methods must be found that would provide a cost-effective way to detect and periodically monitor activities requiring permits. One candidate for this application was the Landsat satellite. The multispectral scanner (MSS) on board the satellite could provide relatively inexpensive and repetitive coverage of large areas of terrain on a regular basis. However, there were some questions regarding the ability of the MSS to resolve small terrain features, the applicability of currently available automatic data-processing techniques and the cost of using Landsat MSS data for monitoring activities. An investigation of the various factors is discussed. Given an understanding of certain limitations concerning the acquired data, an interpreter can extract from a Landsat-derived image information that is valuable from the standpoint of the Regulatory Permit Program. G.R.

A81-43216 Improving stream flow estimates through the use of Landsat. G. J. Allord (U.S. Geological Survey, Water Resources Div., Madison, WI) and F. L. Scarpace (Wisconsin, University, Madison, WI). In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979.
Minneapolis, MN, American Water Resources Association, 1981, p. 284-291. 7 refs.

Using new estimates of land cover in multiple regression techniques, the standard error of estimate (SE) for the least annual 7-day low flow for 2- and 10-year recurrence intervals of ungaged sites are lowered by 9 percent each. The SE of flood frequency in the 'Driftless Area' of Wisconsin for 10-, 50-, and 100-year recurrence intervals are lowered by 14 percent. Four of nine basin characteristics determined from satellite imagery are significant variables in the multiple regression techniques, whereas only 1 of the 12 characteristics determined from topographic maps is significant. The percentages of land cover categories in each basin are determined by merging basin boundaries, digitized from quadrangles, with a classified Landsat scene. Both the basin boundary X-Y polygon coordinates and the satellite coordinates are converted to latitude-longitude for merging compatibility. C.R.

A81-43217 Flood applications of satellite imagery. J. Kruus, H. L. Ferguson (Environment Canada, Atmospheric Environment Service, Ottawa, Canada), M. Deutsch (U.S. Geological Survey, Reston, VA), and P. L. Hansen (New Brunswick, Dept. of the Environment, Fredericton, Canada). In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979.

Minneapolis, MN, American Water Resources Association, 1981, p. 292-301. 7 refs.

Various techniques that can be used to derive information relevant to floods from satellite imagery are illustrated. Multistage sampling makes use of Landsat images and aerial photography at various scales to outline flood damage from a regional scale to single fields. It is noted that multispectral composites may be made to enhance such features as standing water or floodplain indicators for measurement of photointerpretation. Temporal composites are useful in comparing flood levels on various dates or, if one of the images shows the normal stage, in measuring flooded area. It is noted that digital mapping methods may also be used in detecting, mapping, and measuring the area covered by water at various stages for derivation of a stage storage curve. C.R.

A81-43218 A note on indirect detection of seiches in Great Salt Lake, Utah, by NOAA and Landsat satellite imagery. M. Matson, C. P. Berg, and D. R. Wiesnet (NOAA, National Earth Satellite Service, Washington, DC). In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979.

Minneapolis, MN, American Water Resources Association, 1981, p. 303-307. 5 refs.

On June 15, 1977, an unusual reflectance anomaly was detected in the north arm of Great Salt Lake, Utah, on NOAA-5 Very High Resolution Radiometer (VHRR) visible band imagery, and later on

Landsat-2 multispectral visual band imagery. Comparison of north arm lake levels with meteorological parameters leads to the conclusion that the anomalous reflectance is associated with wind induced seiches in the north arm. Apparently, the wind induces anomalous current patterns and higher than usual current speeds and waves in the western part of the north arm; these currents and waves then entrain the fine grained sediments of the shallow lake bottom, thus increasing the turbidity and hence the reflectance of surface waters. (Author)

A81-43219 Assessing the Red River of the North 1978 flooding from NOAA satellite data. C. P. Berg, D. R. Wiesnet, and M. Matson (NOAA, National Earth Satellite Service, Washington, DC). In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979. Minneapolis, MN, American Water Resources Association, 1981, p. 309-315. 5 refs.

Thermal infrared (IR) Very High Resolution Radiometer (VHRR) data from the polar-orbiting NOAA-5 satellite are used to map the spring 1978 flooding on the Red River of the North. The twice-daily VHRR-IR coverage provides good flood extent mapping capability for small rivers having broad flood plains such as the Red River of the North (basin area 101,519 square kilometers). Flood extent is delineated using computer-enhanced, enlarged thermal IR images mapped onto 1:1,000,000 base maps and compared to ground-based hydrologic data. The resulting maps show the flood-inundated areas and the changes that occur as the flood proceeds downstream. (Author)

A81-43220 A preliminary analysis of SAR mapping of the Manitoba flood, May 1979. R. T. Lowry (Intera Environmental Consultants, Ltd., Ottawa, Canada), N. Mudry (Manitoba, Dept. of Mines, Natural Resources and Environment, Winnipeg, Canada), and E. J. Langham. In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979. Minneapolis, MN, American Water Resources Association, 1981, p. 316-323.

A preliminary evaluation is presented of SAR imagery obtained of the flooding of the Red River in Manitoba in May, 1979 as part of the Sursat Program to determine Canadian needs for a surveillance satellite and the appropriate sensors to be used to meet those needs. The area of the flooding was mapped with an airborne synthetic aperture radar based on the ERIM four-channel SAR which consists of two dual polarized radars operating in the L and X bands, which was operated in the steep mode to simulate satellite observations. The imagery was processed to obtain maps of 1:250,000 and 1:500,000 scale which can be used to establish the actual extent of the flooding. The X-band is found to provide a better image, in part due to its higher resolution and shorter wavelength. Results demonstrate that an airborne SAR can provide all-weather flood area delineation, although satellite-borne radar, with steep depression angles, lower resolution and lower frequency, may not be able to delineate floods without special image processing. A.L.W.

A81-43226 Ground water and satellites - An overview/ introduction. W. A. Pettyjohn (Oklahoma State University, Stillwater, OK). In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979. Minneapolis, MN, American Water Resources Association, 1981, p. 385, 386.

Remote sensing reports have improved dramatically in the past few years because of highly sophisticated automatic data processing. Unfortunately, much of the information is of limited practical value to local, state, or federal agencies, as well as other potential users. Satellite data, in several disciplines, has been less than satisfactory, not because it isn't suited to a specific application, but rather because so few use it. This is the result of poor communication, which can be overcome, in part, by publishing our findings more widely and by producing applications oriented, readable reports. (Author)

A81-43229 Hydrogeologic interpretations of Landsat imagery in arid zones of South and West Africa. W. Kruck (Bundesanstalt für Geowissenschaften und Rohstoffe, Hanover, West Germany). In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979. Minneapolis, MN, American Water Resources Association, 1981, p. 408-415. 8 refs.

A81-43231 Observations on Lake Ontario basin hydrogeology from optical enhancements of Landsat imagery. A. Falconer, L. Myers (Library of Parliament, Ottawa, Canada), and M. Deutsch (U.S. Geological Survey, Reston, VA). In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979. Minneapolis, MN, American Water Resources Association, 1981, p. 427-436. 8 refs. U.S. Geological Survey Contracts No. 14-08-0001-13169; No. 14-08-0001-3185.

Before the close of the International Hydrological Decade (IHD), the launch of Landsat 1 in 1972 made possible the collection and analysis of satellite images showing the entire Lake Ontario drainage basin. An assessment was made of Landsat imagery and prelaunch aircraft analog data to determine their usefulness in assisting IHD investigators to define the regional hydrological characteristics of the basin. By using a composite of July data from MSS bands 4, 5, and 7, reprocessing of standard EDC products leads to the production of a low-cost detailed synoptic view of vegetation distribution and land use in the Lake Ontario basin. A temporal series of two scene Landsat mosaics of the western Lake Ontario region provide an information base for interpreting hydrological conditions from snow distribution, ice melting patterns, and vegetation anomalies indicative of ground water discharge or the presence of shallow aquifers. B.J.

A81-43233 * Ground water applications of the heat capacity mapping mission. J. L. Heilman (Texas A & M University, College Station, TX) and D. G. Moore (South Dakota State University, Brookings, SD). In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979. Minneapolis, MN, American Water Resources Association, 1981, p. 446-449. U.S. Geological Survey Contract No. 14-08-0001-12510; Contract No. NAS5-24206.

The paper discusses the ground water portion of a hydrologic investigation of eastern South Dakota using data from the Heat Capacity Mapping Mission (HCMM) satellite. The satellite carries a two-channel radiometer (0.5-1.1 and 10.5-12.5 microns) in a sun synchronous orbit and collects data at approximately 0230 and 1330 local standard time with repeat coverage of 5 to 16 days depending on latitude. It is shown that HCMM data acquired at appropriate periods of the diurnal and annual temperature cycle can provide useful information on shallow ground water. V.L.

A81-43234 * Landsat classification of coastal wetlands in Texas. R. J. Finley (Texas, University, Austin, TX), S. McCulloch (Texas Natural Resources Information System, Austin, TX), and P. Harwood (National Governor's Association, Council of State Planning Agencies, Washington, DC). In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979.

Minneapolis, MN, American Water Resources Association, 1981, p. 453-462. 15 refs. Contract No. NAS5-20986.

Through a multiagency study of Landsat imagery applications, an analysis of Texas coastal wetlands shows that five Level III categories of wetlands can be delineated using image interpretation: topographically low marshes, topographically high marshes, tidal flats, sea grass and algal flats, and vegetated dredged material. Image interpretation involves optical enlargement of 1:1,000,000 scale, Landsat transparencies to a scale of 1:125,000 and mapping on a stable film base. Digital classification procedures, resulting in 1:24,000 scale line printer maps as output, require several iterations to display welands effectively. Accuracies of 65% were achieved for all wetland categories combined. B.J.

A81-43235 Accuracy evaluation of Landsat digital classification of vegetation in the Great Dismal Swamp. P. T. Gammon (U.S. Geological Survey, Suffolk, VA), W. G. Rohde (U.S. Geological Survey, EROS Data Center, Sioux Falls, SD), and V. Carter (U.S. Geological Survey, Reston, VA). In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979.

Minneapolis, MN, American Water Resources Association, 1981, p. 463-473. 9 refs.

A81-43236 * Using Landsat MSS data with soils information to identify wetland habitats. C. L. Ernst and R. M. Hoffer (Purdue University, Lafayette, IN). In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979.
Minneapolis, MN, American Water Resources Association, 1981, p. 474-478. 6 refs. Grant No. NGL-15-005-186.

A previous study showed that certain fresh water wetland vegetation types can be spectrally separated when a maximum likelihood classification procedure is applied to Landsat spectral data. However, wetland and upland types which have similar vegetative life forms (e.g., upland hardwoods and hardwood swamps) are often confused because of spectral similarity. Therefore, the current investigation attempts to differentiate similar wetland and upland types by combining Landsat multispectral scanner (MSS) data with soils information. The Pigeon River area in northern Indiana used in the earlier study was also employed in this investigation. A layered classification algorithm which combined soils and spectral data was used to generate a wetland classification. The results of the spectral/soils wetland classification are compared to the previous classification that had been based on spectral data alone. The results indicate wetland habitat mapping can be improved by combining soils and other ancillary data with Landsat spectral data. (Author)

A81-43237 * Improvements in lake volume predictions using Landsat data. J. C. Gervin (NASA, Goddard Space Flight Center, Greenbelt, MD) and S. F. Shih (Florida, University, Belle Glade, FL). In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979. Minneapolis, MN, American Water Resources Association, 1981, p. 479-484. NASA-supported research.

A cumulative error in the water balance budget for Lake Okeechobee produces a one million acre-foot discrepancy in the predicted water volume over a 4-year period. The major source of error appears to be complex shoreline marshes that comprise 20 percent of the lake surface. The water balance budget model presently treats these marshes as open water. Using Landsat data, the vegetation in the lake's littoral zone was classified multispectrally to provide a data base for determining water budget information. First, the acreage of a given plant species in the littoral zone was obtained with satellite data. Second, the surface area occupied by plants (which therefore could not be considered open water) was used to adjust the vegetation acreage giving an effective water surface. Based on this information, more detailed representations of evapotranspiration and total water surface (and hence total lake volume) could be provided to the water balance budget computation. (Author)

A81-43238 * Landsat hydrobiological classification for an inland fresh water marsh within Everglades National Park. P. W. Rose and P. C. Rosendahl (U.S. National Park Service, South Florida Research Center, Homestead, FL). In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979.
Minneapolis, MN, American Water Resources Association, 1981, p. 485-491. NASA-supported research.

The considered investigation is concerned with the application of Landsat Multispectral Scanner (MSS) data to the classification of vegetative communities and the establishment of flow vectors for the Shark River Slough in Everglades National Park, Florida. A systematic array of 'ground truth' was established utilizing comprehensive hydrologic field data and conventional high altitude infrared aerial photography. A control network was defined that represented all hydrobiological zones (those wetland vegetative communities that directly influence the rate of overland sheet flow) in the Shark River Slough. These data were then directly applied to the Landsat imagery utilizing an interactive multispectral processor which generated hydrographic maps of the slough and defined the surface radiance characteristics of each hydrobiological system. It was found that the application of Landsat imagery for hydrologic applications in a wetlands area, such as the Shark River Slough in Everglades National Park, is definitely a viable tool for resource management. G.R.

A81-43239 * A comparison of remote sensing techniques for Minnesota wetlands classification. L. F. Werth (Lockheed Electronics Co., Inc., Houston, TX) and M. P. Meyer (Minnesota, University, St. Paul, MN). In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979.
Minneapolis, MN, American Water Resources Association, 1981, p. 492-498. 8 refs. Research supported by the University of Minnesota and NASA.

A wetland classification study in a typically complex 650 sq km test site in east central Minnesota compared the time, cost and accuracy of manually interpreted 1:24,000 scale color infrared aerial photographs with digital analysis of Landsat data. The comparison was between the same general wetland and non-wetland classes; accuracy of both systems was evaluated with intensive ground verification. For the same general classes, the overall mapping accuracy was 96 percent for the aerial photo interpretation and 71 percent for Landsat double-date classification. Results with maximum likelihood and SECHO classifiers were the same, 71 percent, while mapping accuracy with a layered classifier was only 66 percent. Compared to a general geometric correction and a single-date data set, geographic position and classification accuracy improved when a precision geometric correction and a double-date data set were used. Landsat digital analysis was faster, 24 vs. 90 days, but photointerpretation was more economical at $0.15/hectare (including all costs of procurement, processing and analysis), compared with Landsat costs of $0.35/hectare (not including costs of data procurement, processing prior to delivery to user and related overhead). (Author)

A81-43240 Landsat interpretation of prairie lakes and wetlands of eastern South Dakota. R. G. Best and D. G. Moore (South Dakota State University, Brookings, SD). In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979. Minneapolis, MN, American Water Resources Association, 1981, p. 499-506. 15 refs. U.S. Geological Survey Contract No. 14-08-0001-13576.

Spectral and morphometric properties of prairie lakes and wetlands can be interpreted on Landsat MSS imagery. Multispectral interpretations for developing water quality sampling strategies are discussed and illustrated. Photographic enhancement techniques including contrast enhancement to depict qualitative turbidity differences, thematic extraction of open water bodies, and temporal compositing for determining the occurrence and distribution of emergent vegetation are presented and illustrated. The statistical accuracy of morphometric measurements, including area length, breadth, mean breadth, and shoreline development index were calculated. Models for estimating average depth and volume were developed and evaluated. (Author)

A81-43241 * A technique for improved assessment of flow resistance characteristics of natural wetlands using Landsat data. J. C. Gervin (NASA, Goddard Space Flight Center, Greenbelt, MD) and S. F. Shih (Florida, University, Bell Glade, FL). In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979. Minneapolis, MN, American Water Resources Association, 1981, p. 507-511. NASA-supported research.

In the past, one value of the roughness coefficient has frequently been used to represent the flow resistance characteristics of the entire natural wetland throughout the year. To improve the simulation of water flow through these natural vegetation communities, Landsat imagery and in situ flow measurements could be combined to produce a more detailed representation of flow resistance. The vegetation in a typical marshland drainage basin in south Florida was classified into five major categories using Landsat data. Flow measurements were then performed at characteristic sites in the basin. The measurements were taken at various depths during months of significant flow to examine the effect of seasonal growth. This information can be compared with the areal extent of the vegetation measured by satellite to more accurately simulate resistance to water flow in natural marshland drainage basins. (Author)

A81-43242 Using Landsat imagery to study the Okavango Swamp, Botswana. S. M. Hutton and T. Dincer. In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora

Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979. Minneapolis, MN, American Water Resources Association, 1981, p. 512-519. 20 refs.

A81-43243 * Computer-implemented remote sensing techniques for measuring coastal productivity and nutrient transport systems. M. K. Butera (NASA, Earth Resources Laboratory, Bay St. Louis, MS). In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979. Minneapolis, MN, American Water Resources Association, 1981, p. 522-532. 21 refs.

An automatic technique has been developed to measure marsh plant production by inference from a species classification derived from Landsat MSS data. A separate computer technique has been developed to calculate the transport path length of detritus and nutrients from their point of origin in the marsh to the shoreline from Landsat data. A nutrient availability indicator, the ratio of production to transport path length, was derived for each marsh-identified Landsat cell. The use of a data base compatible with the Landsat format facilitated data handling and computations. (Author)

A81-43249 * Applications of Landsat imagery to a coastal inlet stability study. Y.-H. Wang (Texas A & M University, Galveston, TX). In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979. Minneapolis, MN, American Water Resources Association, 1981, p. 579-584. 6 refs. NASA-sponsored research.

Polcyn and Lyzenga (1975) and Middleton and Barber (1976) have demonstrated that it is possible to correlate the radiance values of a multispectral imagery, such as Landsat imagery, with the depth related information. The present study is one more example of such an effort. Two sets of Landsat magnetic tape were obtained and displayed on the screen of an Image-100 computer. Spectral analysis was performed to produce various signatures, their extent, and location. Subsequent ground truth observations and measurements were gathered by means of hydrographic surveys and low altitude aerial photographs for interpretation and calibration of the Landsat data. Finally, a coastal engineering assessment based on the Landsat data was made. Recommendations regarding the navigational canal alignment and dredging practice are presented in the light of inlet stability. (Author)

A81-43252 Using enhanced Landsat images for calibrating real time estuarine water quality models. J. M. Hill (Louisiana State University, Baton Rouge, LA) and D. S. Graham (Tudor Engineering Co., San Francisco, CA). In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979. Minneapolis, MN, American Water Resources Association, 1981, p. 603-614. 20 refs. Research supported by the U.S. Environmental Protection Agency; Grant No. NOAA-04-158-44046.

A study of the effects of silvicultural activities and associated channelization upon the quality of the receiving waters of Apalachiocola Bay in north Florida is utilizing Landsat images and data to verify real time estuarine water quality models. Management of estuarine water resources requires that accurate mathematical paradigms of circulation and quality be made in order to evaluate the effects of different alternative scenarios. For such paradigms to be predictive in estuaries, it has been demonstrated that they must be in so called 'real time' in which the timestep is much shorter than the tidal period. Verification of such models requires good synoptic data. These are usually impossible to acquire as the time required to traverse the estuary by boats results in measurements being taken over most of the tidal cycle, while continuous observations taken at fixed points provide inadequate spatial resolution at practical staffing levels. Circulation patterns in several specially enhanced Landsat images show good comparison to output of finite element two-dimensional (2-D) vertically averaged models of Apalachicola Bay, hence, information can be applied to both calibrate and verify estuarine water quality models. (Author)

A81-43253 * An application of Landsat and computer technology to potential water pollution from soil erosion. W. J. Campbell (NASA, Goddard Space Flight Center, Greenbelt, MD). In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979. Minneapolis, MN, American Water Resources Association, 1981, p. 616-621. 5 refs.

Agricultural activity has been recognized as the primary source of nonpoint source water pollution. Water quality planners have needed information that is timely, accurate, easily reproducible, and relatively inexpensive to utilize to implement 'Best Management Practices' for water quality. In this paper, a case study shows how the combination of satellite data, which can give accurate land-cover/land-use information, and a computerized geographic information system, can assess nonpoint pollution at a regional scale and be cost effective. (Author)

A81-43254 * Bay of Fundy verification of a system for multidate Landsat measurement of suspended sediment. J. C. Munday, Jr. (Virginia Institute of Marine Science; College of William and Mary, Gloucester Point, VA), T. T. Afoldi (Canada Centre for Remote Sensing, Ottawa, Canada), and C. L. Amos (Geologic Survey of Canada, Bedford Institute of Oceanography, Dartmouth, Nova Scotia, Canada). In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979. Minneapolis, MN, American Water Resources Association, 1981, p. 622-640. 39 refs. Grant No. NGL-47-022-005.

A system for automated multidate Landsat CCT MSS measurement of suspended sediment concentration (S) has been implemented and verified on nine sets (108 points) of data from the Bay of Fundy, Canada. The system employs 'chromaticity analysis' to provide automatic pixel-by-pixel adjustment of atmospheric variations, permitting reference calibration data from one or several dates to be spatially and temporally extrapolated to other regions and to other dates. For verification, each data set was used in turn as test data against the remainder as a calibration set: the average absolute error was 44 percent of S over the range 1-1000 mg/l. The system can be used to measure chlorophyll (in the absence of atmospheric variations), Secchi disk depth, and turbidity. (Author)

A81-43255 Assessment and classifications of selected Illinois lakes through the application of space technology. D. J. Schaeffer, R. P. Clarke, D. F. Sefton (Illinois Environmental Protection Agency, Springfield, IL), and D. H. P. Boland (USAF, Wright-Patterson AFB, OH). In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979. Minneapolis, MN, American Water Resources Association, 1981, p. 641-648. 8 refs.

Selected Illinois lakes were assessed and classified by: (1) applying a complete linkage clustering algorithm to Landsat MSS data and interpreting the clusters by comparing the spectral composition and uniqueness of each with water quality data, field evaluations, lake morphology, and watershed characteristics; and (2) using Landsat spectral ranks as independent variables and contact-sensed data as dependent variables for the development of multiple regression models to obtain estimates of trophic indicator parameters and multivariate trophic indices and, subsequently, lake trophic state rankings and groupings. Cluster analysis of the raw spectral data established distinctive lake groups, each comprised of water bodies having similar optical and physical properties. The spectral properties of each lake provided an integrated characterization of water quality and related use impairment problems. The trophic parameter estimates, as well as lake clusters and rankings derived from them, were in general agreement with contact-sensed data and with the raw spectral data. (Author)

A81-43256 Thermal patterns of Lake Michigan and Lake Superior from satellite remote sensors and its uses. H. W. Hoffman (NOAA, National Weather Service, Rosemont, IL). In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979. Minneapolis, MN, American Water Resources Association, 1981, p. 650-653.

Average surface water temperature maps have been drawn for Lake Michigan and Lake Superior in order to understand short- and long-range thermal patterns. The data used were generated over a two-year period from the Very High Resolution Radiometer on NOAA-4 and -5 satellites. Results indicate that the waters of Lake Michigan and Lake Superior as observed from satellite imagery act in similar manner as any other large and deep body of water in that

fluctuations in water temperature occur very gradually, except for upwelling effects near the shore. The high specific heat of these water bodies has a profound effect on climatic conditions of adjacent air and land masses. V.L.

A81-43257 Lake Ontario dynamics and water quality observations using thematically enhanced Landsat data. A. Falconer (Spectral Data Corp., Regional Remote Sensing Facility, Nairobi, Kenya), M. Deutsch (U.S. Geological Survey, Reston, VA), and L. Myers (Library of Parliament, Ottawa, Canada). In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979. Minneapolis, MN, American Water Resources Association, 1981, p. 655-661. 15 refs. U.S. Geological Survey Contracts No. 14-08-0001-13169; No. 14-08-0001-13185.

The considered study is concerned with the use of satellite data for the identification of phenomena observed in western Lake Ontario. Ships and aircraft have been generally employed for gathering knowledge about the Great Lakes. It is pointed out that space technology has the potential to greatly increase the efficiency and effectiveness of lake monitoring programs. Satellites such as Landsat can obtain synoptic and repetitive views useful for guiding ships and aircraft to areas where more detailed studies are needed. An investigation is conducted of the techniques for photo-optical reprocessing of Landsat images and computer processing of digital Landsat data to enhance water quality information and to determine the appropriate use of each method. It is found that Landsat is an excellent source of synoptic data indicative of the dynamics of Lake Ontario and its water quality conditions. Landsat data needs to be specially processed (thematically enhanced) to depict anomalies indicative of water quality of dynamics. G.R.

A81-43258 * Application of digital image processing techniques and information systems to water quality monitoring of Lake Tahoe. A. Y. Smith and R. J. Blackwell (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA). In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979. Minneapolis, MN, American Water Resources Association, 1981, p. 662-672. 8 refs.

The Tahoe basin occupies over 500 square miles of territory located in a graben straddling the boundary between California and Nevada. Lake Tahoe contains 126 million acre-feet of water. Since the 1950's the basin has experienced an ever increasing demand for land development at the expense of the natural watershed. Discharge of sediment to the lake has greatly increased owing to accelerated human interference, and alterations to the natural drainage patterns are evident in some areas. In connection with an investigation of the utility of a comprehensive system that takes into account the causes as well as the effects of lake eutrophication, it has been attempted to construct an integrated and workable data base, comprised of currently available data sources for the Lake Tahoe region. Attention is given to the image based information system (IBIS), the construction of the Lake Tahoe basin data base, and the application of the IBIS concept to the Lake Tahoe basin. G.R.

A81-43259 * Trophic state determination for shallow coastal lakes from Landsat imagery. C. W. Welby, A. M. Witherspoon (North Carolina State University, Raleigh, NC), and R. E. Holman, III (North Carolina Div. of Environmental Management, Edenton, NC). In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979. Minneapolis, MN, American Water Resources Association, 1981, p. 674-680. 20 refs. Contract No. NAS8-31984.

A study has been carried out to develop a photo-optical technique by which Landsat imagery can be used to monitor trophic states of lakes. The proposed technique uses a single number to characterize the trophic state, and a feature within the satellite scene is used as an internal standard for comparison of the lakes in time. By use of the technique it is possible to assess in retrospect the trophic state of each individual lake. V.L.

A81-43356 # Annual and interannual variations in outgoing longwave radiation over the tropics. T. R. Heddinghaus and A. F. Krueger (NOAA, Climate Analysis Center, Washington, DC). *Monthly Weather Review*, vol. 109, June 1981, p. 1208-1218. 25 refs. NOAA-supported research.

Four years of satellite observations of the outgoing longwave radiation have been used to study the distribution of cloudiness and rainfall over the tropics. Annual and interannual variations are described, partially with the help of an eigenvector analysis. Interannual variations in the outgoing longwave radiation are particularly interesting since they tend to follow the Southern Oscillation. Consequently, it can be used to monitor changes in the large-scale circulation over the tropics. (Author)

A81-43538 Remote sensing of dinoflagellate blooms in a turbid estuary. J. C. Munday, Jr. and P. L. Zubkoff (Virginia Institute of Marine Science, Gloucester Point, VA). *Photogrammetric Engineering and Remote Sensing*, vol. 47, Apr. 1981, p. 523-531. 36 refs.

Dinoflagellate blooms in sediment-laden waters of the York River, Virginia consistently produced reflectance decreases in visible bands, but produced equivocal changes in the photographic infrared. The equivocal infrared changes are due to simultaneous variations in chlorophyll and inorganic suspended sediment concentrations, as interpreted with a reflectance model. Equations are developed to show what conditions of changing chlorophyll and sediment can produce invariant reflectance. Color photography of dinoflagellate blooms in turbid estuaries portrays chlorophyll distributions with limited accuracy. The complexity of the spatial distributions necessitates remote sensing for synoptic mapping. (Author)

A81-43543 Mapping wetlands using orthophotoquads and 35-mm aerial photographs. R. A. Mead (Virginia Polytechnic Institute and State University, Blacksburg, VA) and P. T. Gammon (U.S. Geological Survey, Suffolk, VA). *Photogrammetric Engineering and Remote Sensing*, vol. 47, May 1981, p. 649-652. 11 refs.

A U.S. Geological Survey 7.5-minute orthophotoquad is used in combination with 35-mm color-infrared aerial transparencies to inventory and map North Carolina wetland areas of interest to regional or local land managers. Orthophotoquads are rectified black-and-white aerial photographs produced in the 7.5-minute, 1:24,000 scale standard map series. These orthophotoquads provide a mapping base of uniform scale upon which many vegetation and land-use boundaries may be delineated. The 35-mm aerial photographs, flown at a larger scale, for example, 1:6,000, along selected transects within the orthophotoquad afford identification of different wetland types. The vegetation types identified on the 35-mm infrared photographs thus assist the interpreter in identifying the desired wetland types on the total wetland area within the quad. In areas where orthophotoquads are available, this method permits resource managers to map wetlands without the need for expensive large format photography. (Author)

A81-43544 * Multisensor analysis of hydrologic features with emphasis on the Seasat SAR. J. L. Foster and D. K. Hall (NASA, Goddard Space Flight Center, Greenbelt, MD). *Photogrammetric Engineering and Remote Sensing*, vol. 47, May 1981, p. 655-664. 13 refs.

Synthetic aperture radar (SAR) imagery of the Wind River Range area in Wyoming is compared with visible and near-infrared imagery of the same area. Data from the Seasat L-Band SAR and an aircraft X-Band SAR are compared with Landsat Return Beam Vidicon (RBV) visible data and near-infrared aerial photography and topographic maps of the same area. It is noted that visible and near-infrared data provide more information than the SAR data when conditions are the most favorable. The SAR penetrates clouds and snow, however, and data can be acquired day or night. Drainage density detail is good on SAR imagery because individual streams show up well owing to riparian vegetation; this causes higher radar reflections which result from the 'rough' surface which vegetation creates. In the winter image, the X-Band radar data show high returns because of cracks on the lake ice surfaces. High returns can also be seen in the L-Band SAR imagery of the lakes due to ripples on the surface induced by wind. It is concluded that the use of multispectral data would optimize analysis of hydrologic features. C.R.

A81-43545 * Use of ocean color scanner data in water quality mapping. S. Khorram (California, University, Berkeley, CA). *Photogrammetric Engineering and Remote Sensing*, vol. 47, May

1981, p. 667-676. 53 refs. Research supported by the University of California; Grant No. NsG-5256.

Remotely sensed data, in combination with in situ data, are used in assessing water quality parameters within the San Francisco Bay-Delta. The parameters include suspended solids, chlorophyll, and turbidity. Regression models are developed between each of the water quality parameter measurements and the Ocean Color Scanner (OCS) data. The models are then extended to the entire study area for mapping water quality parameters. The results include a series of color-coded maps, each pertaining to one of the water quality parameters, and the statistical analysis of the OCS data and regression models. It is found that concurrently collected OCS data and surface truth measurements are highly useful in mapping the selected water quality parameters and locating areas having relatively high biological activity. In addition, it is found to be virtually impossible, at least within this test site, to locate such areas on U-2 color and color-infrared photography. C.R.

A81-43548 Hydrogeology of glacial deposits from aerial photographs. E. K. Sauer (Saskatchewan, University, Saskatoon, Canada). *Photogrammetric Engineering and Remote Sensing,* vol. 47, June 1981, p. 811-822. 28 refs.

It is pointed out that aerial photographs present a unique vertical perspective of certain landscape features which exist as expressions of the hydrogeology of an area. Geological processes interpreted from aerial photographs define ground-water systems and boundary conditions in glaciated terrain. The ground-water flow system within this framework is indicated on black-and-white photographs by springs, tone patterns, vegetation indicators, salinity of surface soils, slope instability, and apparent anomalies in streams and floodplains. Direct and indirect evidence of recharge and storage is often evident because of the landscape features. Discharge phenomena tend to be the most apparent, however. G.R.

A81-43549 Wetland mapping from digitized aerial photography. F. L. Scarpace, B. K. Quirk, R. W. Kiefer, and S. L. Wynn (Wisconsin, University, Madison, WI). *Photogrammetric Engineering and Remote Sensing,* vol. 47, June 1981, p. 829-838. 32 refs.

Computer classification of digitized aerial imagery for wetland mapping was investigated. A comparison was made between digital and manual interpretation of a high altitude color infrared photograph. The resulting computer classification was approximately 90 percent accurate. Digital analysis of aerial imagery provides high resolution information and could provide an operational method for monitoring and mapping wetlands. (Author)

A81-43742 * Mapping the Great Salt Lake shoreline and associated waterfowl habitat from Landsat data. J. Boissonnault (Utah, University, Salt Lake City, UT) and R. G. Witt (NASA, Goddard Space Flight Center, Greenbelt, MD). In: Rainbow 80; Fall Technical Meeting, Niagara Falls, NY, October 7-10, 1980, ASP Technical Papers. Falls Church, VA, American Society of Photogrammetry, 1981, p. RS-3-A-1 to RS-3-A-7.

A81-43745 * Manual versus digital Landsat analysis for modeling river flooding. W. R. Philipson and W. R. Hafker (Cornell University, Ithaca, NY). In: Rainbow 80; Fall Technical Meeting, Niagara Falls, NY, October 7-10, 1980, ASP Technical Papers. Falls Church, VA, American Society of Photogrammetry, 1981, p. RS-3-D-1 to RS-3-D-10. 8 refs. Grant No. NGL-33-010-171. DI Project A-089-NY.

The comparative value of manual versus digital image analysis for determining flood boundaries is being examined in a study of the use of Landsat data for modeling flooding of the Black River, in northern New York. The work is an extension of an earlier study in which Black River flooding was assessed through visually interpreted, multi-date Landsat band 7 images. Based on the results to date, it appears that neither color-additive viewing nor digital analysis of Landsat data provide improvement in accuracy over visual analysis of band 7 images, for delineating the boundaries of flood-affected areas. (Author)

A81-43746 Preliminary survey of HCMM satellite thermal imagery as applied to hydrospherics. D. R. Wiesnet, D. F. McGinnis, Jr., M. Matson, and J. A. Pritchard (NOAA, National Environmental Satellite Service, Washington, D.C.). In: Rainbow 80; Fall Technical Meeting, Niagara Falls, NY, October 7-10, 1980, ASP Technical Papers. Falls Church, VA, American Society of Photogrammetry, 1981, p. RS-3-E-1 to RS-3-E-12. 14 refs.

NASA's Heat Capacity Mapping Mission satellite, launched April 26, 1978 to an orbital altitude of 620 km, provides day/night thermal (10.5-12.5 micron) coverage on a regular basis. The satellite, having exceptional thermal and spatial resolution, has been used to study hydrospheric features. Estuarine tidal circulation monitoring is demonstrated in large systems; some degree of tidal circulation is inferred from thermal patterns even in small estuaries. Details of transient circulation features such as eddies are studied synoptically, and details of tidal currents are readily mapped. Attempts to estimate soil moisture from thermal patterns and/or thermal inertia measurements are complicated by canopy temperatures and geomorphology. Delineation and measurement of urban heat islands are shown to be useful for demographic studies and for determinining the effect of anthropogenic changes on mesoscale climates. J.F.

A81-43747 Southern Chesapeake Bay circulation and suspended sediment transport analyzed using Landsat imagery. J. C. Munday, Jr. and M. S. Fedosh (College of William and Mary, Gloucester Point, VA). In: Rainbow 80; Fall Technical Meeting, Niagara Falls, NY, October 7-10, 1980, ASP Technical Papers. Falls Church, VA, American Society of Photogrammetry, 1981, p. RS-3-F-1 to RS-3-F-5. 12 refs.

Fifty dates of Landsat images of the southern Chesapeake Bay are under study for circulation patterns and suspended sediment transport as a function of wind, tide, and fresh water inflow conditions. Methods of analysis include visual interpretation and color-coded density slicing of MSS 5 images coupled with color-additive viewing of MSS 4 to 7 images. At the Bay mouth, flood tide plumes are prominent on the north side, and ebb plumes carrying James River sediments on the south. A turbidity increase follows the progressive tidal wave of maximum current in its passage up the Bay. Plumes are oriented downwind. Winter and spring turbidities, in association with strong northerly winds, are higher than in summer. (Author)

A81-45429 * Water quality mapping from Landsat digital data. S. Khorram (California, University, Berkeley, CA; North Carolina State University, Raleigh, NC). *International Journal of Remote Sensing,* vol. 2, Apr.-June 1981, p. 145-153. 37 refs. Research supported by the University of California; Grant No. NsG-5256.

A81-46045 * Mapping alpine soils using color positive and color infrared photographs. S. Burns (Colorado, University, Boulder, CO). In: Machine processing of remotely sensed data and soil information systems and remote sensing and soil survey; Proceedings of the Sixth Annual Symposium, West Lafayette, IN, June 3-6, 1980. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 214-220. 11 refs. Grant No. NGL-06-003-200.

During a soil survey of the Indian Peaks area of the Colorado Front Range, it was found that large scale color positive photographs taken in the autumn were extremely useful for mapping alpine soils. Smaller scale color infrared photos were also helpful for delineation of mapping units. The soil mapping units were deduced on the basis of landforms and snow accumulation which is reflected in patterns of vegetational communities. (Author)

A81-46405 * Manual versus digital Landsat analysis for delineating river flooding. W. R. Philipson and W. R. Hafker (Cornell University, Ithaca, NY). *Photogrammetric Engineering and Remote Sensing,* vol. 47, Sept. 1981, p. 1351-1356. 8 refs. Grant No. NGL-33-010-171. DI Project A-089-NY.

It has been found that flood boundary information derived from Landsat images, acquired at different flood stages, could be used to develop an empirical model for estimating the extent of flooding on the basis of in situ measurements of river discharge. An investigation was undertaken to determine whether improved results might have been obtained through digital image analysis or by including other Landsat spectral bands. The study area encompasses a highly flood-prone reach of the Black River in Lewis County, NY. It was found that visual analysis of aerial photographs and a Landsat band 7 image gave similar results. Visual and digital analysis of Landsat band 7 data gave similar results, and digital analysis of Landsat band 7 data

gave results which were at least as good as digital analysis of combinations of spectral bands. G.R.

A81-47356 Monitoring of snow covered area using satellite data. H. Ochiai (Toba Merchant Marine College, Toba, Mie, Japan) and K. Takeda (Science and Technology Agency, National Institute of Natural Resources, Tokyo, Japan). *International Astronautical Federation, International Astronautical Congress, 32nd, Rome, Italy, Sept. 6-12, 1981, Paper 81-114.* 12 p.

It is pointed out that the detection of snow regions in Japan by Landsat MSS and RBV is recognized as being more effective than the snow depth distribution maps compiled from data from snow survey stations. High-resolution data obtained by NOAA AVHRR is also considered suitable for monitoring snow covered areas. C.R.

A81-47647 * # Airborne simultaneous spectroscopic detection of laser-induced water Raman backscatter and fluorescence from chlorophyll a and other naturally occurring pigments. F. E. Hoge (NASA, Wallops Flight Center, Wallops Island, VA) and R. N. Swift (EG & G Washington Analytical Services Center, Inc., Pocomoke City, MD). *Applied Optics,* vol. 20, Sept. 15, 1981, p. 3197-3205. 22 refs.

The airborne laser-induced spectral emission bands obtained simultaneously from water Raman backscatter and the fluorescence of chlorophyll and other naturally occurring waterborne pigments are reported here for the first time. The importance of this type data lies not only in its single-shot multispectral character but also in the application of the Raman line for correction or calibration of the spatial variation of the laser penetration depth without the need for in situ water attenuation measurements. The entire laser-induced fluorescence and Raman scatter emissions resulting from each separate 532-nm 10-nsec laser pulse are collected and spectrally dispersed in a diffraction grating spectrometer having forty photomultiplier tube detectors. Results from field experiments conducted in the North Sea and the Chesapeake Bay/Potomac River are presented. Difficulties involving the multispectral resolution of the induced emissions are addressed, and feasible solutions are suggested together with new instrument configurations and future research directions. (Author)

A81-47676 # Use of water Raman emission to correct airborne laser fluorosensor data for effects of water optical attenuation. M. Bristow, D. Nielsen, D. Bundy, and R. Furtek (U.S. Environmental Protection Agency, Environmental Monitoring Systems Laboratory, Las Vegas, NV). *Applied Optics,* vol. 20, Sept. 1, 1981, p. 2889-2906. 42 refs.

It is shown that the interference from changes in optical attenuation experienced during airborne fluorosensor measurements of fluorophore concentrations in surface waters can be eliminated, by normalizing the fluorescence signal with the concurrent water Raman signal. In a remote, chlorophyll a concentration monitoring application of the principle in fresh waters, the Raman-corrected chlorophyll a fluorescence measurements were found to (1) be highly correlated with chlorophyll a ground truth data, and (2) have a water Raman signal reciprocal that varied directly as the beam attenuation coefficient. It is suggested that this latter relationship be exploited as a technique for remotely sensing changes in surface water optical attenuation. O.C.

A81-48554 * # Airborne microwave radiometer remote sensing of lake ice. C. T. Swift, R. F. Harrington, and H. F. Thornton (NASA, Langley Research Center, Hampton, VA). In: EASCON '80; Electronics and Aerospace Systems Conference, Arlington, VA, September 29-October 1, 1980, Conference Record.

New York, Institute of Electrical and Electronics Engineers, 1980, p. 369-373. 5 refs.

The NASA Langley C-Band Stepped Frequency Microwave Radiometer was used to conduct airborne remote sensing measurements of the Great Lakes ice cover during the winters of 1978 and 1979. In order to evaluate the use of microwave radiometry for remote sensing of fresh water ice, an initial experiment was conducted in February 1978. After the results were analyzed an algorithm was developed, and a more comprehensive mission was completed in March 1979, which related the thermal emission from lake ice to meaningful geophysical quantities. A clear discrimination of pressure ridges and rubble from base ice was observed, and evidence was found which showed gradual changes in the thickness of the base itself. Results indicate that passive microwave sensors can provide a measure of lake ice within uncertainties presented by the attenuation coefficient, and the changes in surface reflectivity imposed by surface roughness. D.L.G.

A81-48941 Suburban soil loss and runoff simulation assisted by interpretation of large scale aerial photography. J. R. Jensen (South Carolina, University, Columbia, SC) and Z. Berger (Exxon Product Research Co., Houston, TX). *Remote Sensing Quarterly,* vol. 3, Jan. 1981, p. 4-20. 27 refs.

A81-48942 * Landsat observations of snowcover depletion and flooding in the Chesapeake Bay area during the winter of 1979. J. Foster (NASA, Goddard Space Flight Center, Earth Survey Applications Div., Greenbelt, MD). *Remote Sensing Quarterly,* vol. 3, Jan. 1981, p. 21-28.

A81-48944 A report on the use of remote sensing techniques for the supervision of New England coastal salt marshes. D. E. Wallace (Nebraska, University, Omaha, NE). *Remote Sensing Quarterly,* vol. 3, Jan. 1981, p. 45-53. 9 refs.

A81-49757 * # Landsat - What is operational in water resources. E. M. Middleton (NASA, Goddard Space Flight Center, Greenbelt, MD) and J. C. Munday, Jr. (Virginia Institute of Marine Science, Gloucester Point, VA). In: Canadian Symposium on Remote Sensing, 6th, Halifax, Canada, May 21-23, 1980, Proceedings. Ottawa, Canadian Aeronautics and Space Institute, 1981, p. 43-52. 35 refs.

Applications of Landsat data in hydrology and water quality measurement were examined to determine which applications are operational. In hydrology, the principal applications have been surface water inventory, and land cover analysis for (1) runoff modeling and (2) abatement planning for non-point pollution and erosion. In water quality measurement, the principal applications have been: (1) trophic state assessment, and (2) measurement of turbidity and suspended sediment. The following applications were found to be operational: mapping of surface water, snow cover, and land cover (USGS Level 1) for watershed applications; measurement of turbidity, Secchi disk depth, suspended sediment concentration, and water depth. B.J.

A81-49761 # Utilisation and benefits of SLAR in operational ice data acquisition. H. G. Hengeveld (Department of the Environment, Atmospheric Environment Service, Downsview, Ontario, Canada). In: Canadian Symposium on Remote Sensing, 6th, Halifax, Canada, May 21-23, 1980, Proceedings.
Ottawa, Canadian Aeronautics and Space Institute, 1981, p. 81-88. 8 refs.

Since 1978, the SLAR system on the Atmospheric Environment Service ice reconnaissance aircraft has been used operationally to provide ice services during more than 3000 hours of reconnaissance flight time. The radar has been modified to include a dry silver processor/display, roll compensation, and sensitivity time control, and is employed together with visual observations and laser surface profiles for the in-flight generation of ice charts. Methods of direct relay of imagery to the user in conjunction with ice charts have been assessed. Primary benefits in the use of SLAR in ice reconnaissance are the large increase in data available to users, the ability to support users during storms, and the accumulation of high data range image records. Future developments will include the use of onboard CRT displays, the improvement of sensitivity time control circuits, and experiments involving improved radar design. B.J.

A81-49778 # Application of synthetic aperture radar data to snow cover monitoring. B. E. Goodison, S. E. Waterman (Department of the Environment, Atmospheric Environment Service, Downsview, Ontario, Canada), and E. J. Langham (Environment Canada, National Hydrology Research Institute, Ottawa, Canada). In: Canadian Symposium on Remote Sensing, 6th, Halifax, Canada, May 21-23, 1980, Proceedings. Ottawa, Canadian Aeronautics and Space Institute, 1981, p. 263-271. 10 refs.

As part of the Canadian Sursat (Surveillance Satellite) project, airborne X and L band synthetic aperture radar (SAR) data were

obtained for a study site in the Ottawa area in November, 1978 and March, 1979, representing snow-free and snow-covered conditions, respectively. Coincident ground based measurements of snowpack properties, soil moisture, and meteorological parameters were collected. The SAR data were used in the form of 70 mm positive transparencies, which were analyzed with the aid of an image analyzer/density slicer. The SAR imagery of the snow-covered site showed a marked change in appearance particularly in the X-band data. In general, the non-forested areas of the study site exhibited a higher X-band radar return in the presence of the snow cover. Variations in the X-band return appear to be a complex function of snowpack properties, including depth, density, free water and water equivalent. In particular, areas of ice and dense snow were observed to produce relatively high radar returns. The L-band data showed little or no relationship between radar return and snowpack properties. The results suggest that SAR data could prove useful for detecting snow cover in non-forested areas. (Author)

A81-49796 # **Airborne estimation of water quality parameters in Lake Ontario.** H. H. Zwick (Canada Centre for Remote Sensing, Ottawa, Canada), S. C. Jain, S. A. Gluckstein (Moniteq, Ltd., Concord, Ontario, Canada), and T. A. Calwell (Genesys Group, Ltd., Ottawa, Canada). In: Canadian Symposium on Remote Sensing, 6th, Halifax, Canada, May 21-23, 1980, Proceedings. Ottawa, Canadian Aeronautics and Space Institute, 1981, p. 443-451. 24 refs.

A81-49797 # **Use of Landsat images in the monitoring and study of the LG 2 reservoir during the filling period (Les images Landsat dans la surveillance et l'étude du réservoir de LG 2 durant la période de remplissage).** P. Laframboise (Société de Développement de la Baie James, Montreal, Canada) and A. Bachand (Société d'Energie de la Baie James, Montreal, Canada). In: Canadian Symposium on Remote Sensing, 6th, Halifax, Canada, May 21-23, 1980, Proceedings. Ottawa, Canadian Aeronautics and Space Institute, 1981, p. 453-457. 5 refs. In French.

The extent of processes associated with the filling of the reservoir behind the LG 2 dam, a part of the La Grande Rivière hydroelectric system in northern Quebec, has been monitored by the use of Landsat 2 and 3 images. Images were acquired starting before the initiation of filling on November 27, 1978 through the end of the following year from the Landsat MSS and RBV instruments. The major stages of dam filling were studied by the visual analysis of the images, including the ecology and physiography of the site before filling, the elevation of vegetation by the rising ice cover, and the turbidity and location of partially flooded vegetation during the free-water period. The major factor limiting the surveillance of the reservoir has been the availability of suitable images, particularly during the summer months. A.L.W.

A81-49800 # **The detection of groundwater discharges /springs/ using aerial thermography.** G. R. Lawrence, D. White (Ministry of Natural Resources, Ontario Centre for Remote Sensing, Toronto, Canada), and I. Deslauriers (Associated Realty Consultants, Goderich, Ontario, Canada). In: Canadian Symposium on Remote Sensing, 6th, Halifax, Canada, May 21-23, 1980, Proceedings. Ottawa, Canadian Aeronautics and Space Institute, 1981, p. 483-491.

A81-49968 * # **Freshwater ice thickness observations using passive microwave sensors.** D. K. Hall, J. L. Foster, A. T. C. Chang, and A. Rango (NASA, Goddard Space Flight Center, Hydrological Sciences Branch, Greenbelt, MD). *IEEE Transactions on Geoscience and Remote Sensing,* vol. GE-19, Oct. 1981, p. 189-193. 11 refs.

Walden Reservoir, a freshwater lake in north-central Colorado, was overflown six times by a NASA C-130 aircraft between January 1977 and April 1980. The aircraft was equipped with four microwave radiometers operating between 0.81 and 6.0 cm in wavelength (37.0 to 5.0 GHz). The 6.0-cm radiometer data showed a good relationship with ice thickness based on a sample of four ice thickness values. The 1.67- and 1.35-cm radiometer data showed weaker relationships with ice thickness. The 0.81-cm sensor data showed no positive relationship with ice thickness. None of the relationships was statistically significant because of the small sample size. The 6.0-cm sensor data in the nadir-viewing mode was found to have the most potential of all the wavelengths studied, for use in remotely determining ice thickness. The 6.0-cm radiometer probably sensed the entire thickness of the ice on the reservoir (ranging from 25.4 to 67.3 cm in thickness) and was apparently not significantly affected by the snow overlying the ice. The shorter wavelengths are scattered by the snow overlying the ice and are more suitable for snow studies than for ice thickness studies. (Author)

N81-29520# Environmental Research Inst. of Michigan, Ann Arbor. Infrared and Optics Lab.
A REMOTE SENSING TECHNIQUE TO MONITOR CLADOPHORA IN THE GREAT LAKES Final Report, 1975 - 1977
Fred J. Tanis Jul. 1980 38 p refs
(Grant EPA-R-803611)
(PB81-173841; EPA-600/3-80-075) Avail: NTIS HC A03/MF A01 CSCL 08H

The feasibility of using an airborne multispectral scanner to monitor shoreline algae problems is demonstrated. Multispectral data were collected at two sites on the U.S. Lake Ontario shoreline. Computer generated color maps were produced to show spatial distribution of Cladophora in the nearshore zone and to estimate standing crop. Spectral features of Cladophora were related to measured standng crop. GRA

N81-30509# Minnesota Univ., Minneapolis. Remote Sensing Lab.
SATELLITE MONITORING OF SNOW EXTENT AND CONDITION IN AGRICULTURAL, TRANSITIONAL, AND FORESTED LAND COVER AREAS Final Report
T. M. Lillesand, D. E. Meisner, A. L. Downs, and R. L. Deuell Dec. 1980 38 p refs
(Grant DOC/NA80AA-D-0019)
(PB81-188625; NOAA-81021104; RSL-RR-80-6) Avail: NTIS HC A03/MF A01 CSCL 08L

GOES and TIROS/NOAA-6 satellite data were evaluated visually and digitally to assess their potential for aiding the process of state wide snow extent mapping in Minnesota. This state contains a geographic continuum spanning from a large open agricultural area, through a partially forested transitional zone, to a heavily forested area. The ability to discriminate snow extent statewide was found to be influenced by the state of sensing and the cover types involved. GRA

N81-33550*# Minnesota Univ., Minneapolis. Space Science Center.
A STUDY OF MINNESOTA LAND AND WATER RESOURCES USING REMOTE SENSING, VOLUME 14 Progress Report, 31 Dec. 1980
1 Jan. 1981 97 p refs Original contains color imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S.D. 57198. ERTS
(Grant NGL-24-005-263)
(E81-10166; NASA-CR-164768) Avail: NTIS HC A05/MF A01 CSCL 05B

Techniques developed for processing and interpreting imagery and for correlating data obtained in the field as well as by aerial and satellite photography are described with particular emphasis on monitoring water quality in lakes, detecting ground water levels, and evaluating moisture stress to plants.

N81-33552*# Minnesota Univ., Duluth. Dept. of Physics.
LAKEWIDE MONITORING OF SUSPENDED SOLIDS USING SATELLITE DATA
Michael Sydor, Principal Investigator *In its* A Study of Minn. Land and Water Resources Using Remote Sensing, Vol. 14 1 Jan. 1981 29 p Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S.D. 57198. ERTS

Avail: NTIS HC A05/MF A01 CSCL 08H

In anticipation of using LANDSAT and Nimbus 7 coastal zone color scanner data to observe the decrease in suspended solids in Lake Superior following cessation of the dumping of taconite tailings, a series of lakewide sampling cruises was conducted to make radiometric measurements at a lake level. A means for identifying particulates and measuring their concentration from LANDSAT data was developed. The initial distribution of chemical parameters in the extreme western arm of the lake, where the concentration gradients are high, is to be based on the LANDSAT data. Subsequent lakewide dispersal and distribu-

tion is to be based on the coastal zone color scanner data.
A.R.H.

N81-33553*# Minnesota Univ., St. Paul. Geological Survey.
SYNERGISTIC RELATIONSHIPS AMONG REMOTE-SENSING AND GEOPHYSICAL MEDIA: GEOLOGICAL AND HYDROLOGICAL APPLICATIONS Final Report
David L. Southwick, Joseph E. Goebel, Matt Walton, Lawrence G. Batten, and James Heutmaker, Principal Investigators *In its* A Study of Minn. Land and Water Resources Using Remote Sensing, Vol. 14 1 Jan. 1981 29 p ref ERTS

Avail: NTIS HC A05/MF A01 CSCL 08G

Skylab photographs, side-looking radar imagery, published soil maps, topographic maps, conventional aerial photography as well as LANDSAT imagery under wet and dry changes for several years were analyzed over selected areas in Minnesota to test their usefulness in detecting near-surface ground water. Results show that optical density read from LANDSAT data is not a reliable discriminator of depth to shallow ground water when one band of one scene is used alone, and is little improved when several bands of several scenes are used synergistically. The method is enhanced if information from soil maps is included in the analysis, especially for discriminating boggy ground from better drained areas. It appears, however, that in areas where soil maps and good topographic maps already exist, the depth to ground water can be predicted from those media as well as (if not better than) it can be predicted from remote imagery. The LANDSAT method used demonstrated no capability for recognizing deeper categories of ground water. A.R.H.

N81-33560*# Cornell Univ., Ithaca, N. Y. School of Civil and Environmental Engineering.
CORNELL UNIVERSITY REMOTE SENSING PROGRAM Semiannual Status Report, 1 Dec. 1980 - 31 May 1981
Warren R. Philipson, Principal Investigator, Ta Liang, and John A. Stanturf Jun. 1981 115 p refs ERTS
(Grant NGL-33-010-171)
(E81-10174; NASA-CR-164567; SASR-18) Avail: NTIS HC A06/MF A01 CSCL 05B

A preliminary methodology was developed for siting windmills and selecting test sites for locating anemometers in Erie, Niagra, and Orleans Counties, New York. Overlays were derived from historic airphotos (1938-1968) of the Love Canal area in an effort to show changes and delineate drainage areas. Projects in progress include assessing scenic views in Hamilton County, New York; developing algorithms for predicting vineyard yield; and a study of the spectral effects of sulfur dioxide on bean yield. Spin-off research includes developing a remote sensing method for improving lake sampling strategies, using digital analysis of LANDSAT data to characterize acid lakes; and studying advanced technologies for environment management and monitoring. A.R.H.

N81-33577*# National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.
A COMPARISON OF OBSERVED AND ANALYTICALLY DERIVED REMOTE SENSING PENETRATION DEPTHS FOR TURBID WATER
W. Douglas Morris, J. W. Usry, William G. Witte, Charles H. Whitlock, and E. A. Guraus Sep. 1981 23 p refs
(NASA-TM-83176) Avail: NTIS HC A02/MF A01 CSCL 08H

The depth to which sunlight will penetrate in turbid waters was investigated. The tests were conducted in water with a single scattering albedo range, and over a range of solar elevation angles. Two different techniques were used to determine the depth of light penetration. It showed little change in the depth of sunlight penetration with changing solar elevation angle. A comparison of the penetration depths indicates that the best agreement between the two methods was achieved when the quasisingle scattering relationship was not corrected for solar angle. It is concluded that sunlight penetration is dependent on inherent water properties only. E.A.K.

N81-33593# Hydrocomp, Inc., Mountain View, Calif.
EVALUATION OF REMOTE SENSING DATA FOR INPUT INTO HYDROLOGICAL SIMULATION PROGRAM-FORTRAN (HSPF) Final Report, Mar. 1979 - Jun. 1980
D. D. Franz and S. M. Lieu Jun. 1981 107 p refs
(Contract EPA-68-01-5801)
(PB81-209561; EPA-600/3-81-037) Avail: NTIS HC A06/MF A01 CSCL 08H

The feasibility of using a remotely sensed data base as input into the hydrologic simulation program-FORTRAN was evaluated (HSPF). Data from LANDSAT and conventionally obtained data were used to set up the input parameters of HSPF. Simulations were run to compare the two sets of data. The remotely sensed data performed as least as well as the conventional one when compared with observed data. in addition, it was estimated to offer savings of 30 to 50 percent in the cost of set up and operations. GRA

N81-33599# Maine Univ., Orono. Land and Water Resources Center.
QUANTIFICATION OF NON-POINT SOURCE SEDIMENTATION THROUGH DENSITOMETRIC ANALYSIS OF COLOR INFRARED AERIAL PHOTOGRAPHY
Terrence J. Keating, Jerry D. Lowry, and Rachel S. Smith Apr. 1981 79 p refs Sponsored by Dept. of Interior
(PB81-209157; W81-03252; OWRT-A-049-ME(2)) Avail: NTIS HC A05/MF A01 CSCL 13B

A method for the detection, quantification, and location of nonpoint pollution sources upon the use of aerial color infrared photography was established. An airborne small format camera system was flown simultaneous to minimal selected ground sampling. This allowed measurement of ground levels of turbidity and suspended solids over relatively large watershed areas. Calibration of monitored rivers was used to assess firm response to given pollutant types; with quantification by densitometry. Suspended solids concentrations from firm density values are estimated. GRA

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07

DATA PROCESSING AND DISTRIBUTION SYSTEMS

Includes film processing, computer technology, satellite and aircraft hardware, and imagery.

A81-41055 **Multispectral texture analysis (Multispektrale Texturanalyse).** M. Dehn (Karlsruhe, Universität, Karlsruhe, West Germany). *Bildmessung und Luftbildwesen,* vol. 49, July 1, 1981, p. 101-110. 5 refs. In German. Research supported by the Deutsche Forschungsgemeinschaft.

The multispectral quality of texture analysis for the classification of land use grades is investigated. A test image, composed of various FMP scenes, is classified using image element features. Extracted texture parameters computed from several spectral bands were found to give better results than the information derived from only one spectral band and greatly reduced the number of incorrect classification allocations. The data to be classified required a detailed investigation in order to extract the parameters which would best describe the object classes. Calculation of the feature extraction parameters required from 60 to 90 minutes for 512 x 512 image elements. J.F.

A81-41057 **A rectification technique for digital orthophoto production (Ein Entzerrungsverfahren zur Herstellung digitaler Orthophotos).** W. Göpfert (Institut für angewandte Geodäsie, Frankfurt am Main, West Germany). *Bildmessung und Luftbildwesen,* vol. 49, July 1, 1981, p. 117-125. 9 refs. In German.

Digital geometrical image processing is applied to a digital/analog converted aerial photograph to produce a digital orthophoto. A rubber stretch algorithm, specifically the multiquadratic interpolation approach, is used as a geometric processing method. DTM data, as well as photogrammetric model evaluation, are used as input data types. Corresponding gray value transfer characteristics are generated to radiometrically adjust the various photographs to be mosaicked. During the digital/analog conversion, optimal image contrasting and selective detail enhancement are obtained. As an example, a digital orthophoto of scale 1:25,000 is produced from 1:62,000 aerial photography using as input terrain profile data obtained through analytical photogrammetry. J.F.

A81-41479 # **Accuracy of transmission of spectral contrasts in multispectral aerial photography, with application to problems of object recognition (O tochnosti peredachi spektral'nykh kontrastov pri mnogozonal'nom aerofotografirovanii primenitel'no k zadacham raspoznavaniia obe'ktov).** Iu. A. Dzhemard'ian, S. V. Komissarenko, and V. G. Skrotskii. In: Some results on the investigation of earth resources by aerial and polygon methods. Leningrad, Gidrometeoizdat, 1980, p. 20-24. In Russian.

An analysis is presented of systematic and random errors arising in the multispectral aerial photography of earth resources; the multispectral method under consideration involves photochemical processing and microphotometry of the multispectral negatives. The use of two recognition models for crop identification on the Kursk test polygon is examined. B.J.

A81-41480 # **Experience with the determination of optical image distortions of landscape elements on IR aerial photographs (Opyt opredeleniia opticheskikh iskazhenii izobrazheniia elementov landshafta na IK aerosnimkakh).** V. A. Kharitonov and V. V. Gorbachev. In: Some results on the investigation of earth resources by aerial and polygon methods. Leningrad, Gidrometeoizdat, 1980, p. 25-33. 8 refs. In Russian.

The paper considers the use of photographic photometry to determine optical image distortions on infrared aerial photographs due to the nonuniformity of angular distribution of reflected radiation. An analysis of experimental aerial photography data confirms the effectiveness of this method. It is concluded that it is necessary to allow for the angular-distribution nonuniformity in the qualitative processing of aerial and spaceborne photographs. B.J.

A81-41481 # **Experience with image combination in multispectral aerial photography (Opyt sovmeshcheniia izobrazhenii mnogozonal'noi aeros'emki).** A. N. Belinskii and I. M. Bokshtein. In: Some results on the investigation of earth resources by aerial and polygon methods. Leningrad, Gidrometeoizdat, 1980, p. 34-37. In Russian.

An interactive method for the combination of images simultaneously obtained in different spectral regions is described. The image combination algorithm consists of four operations: elimination of the nonuniformity of illumination, adaptive quantization, determination of contours, and the correlation of reference sections and the final combination of images. The use of this technique in the automated classification of multispectral images is considered. B.J.

A81-41482 # **Machine method for the equalization of average phototone in an aerial photograph field (Mashinnyi metod vyravnivaniia srednego fotoTona po poliu aerofotoizobrazheniia).** G. G. Andreev and N. N. Koptseva. In: Some results on the investigation of earth resources by aerial and polygon methods.

Leningrad, Gidrometeoizdat, 1980, p. 38-41. In Russian.

The paper examines aspects of the computer correction of the phototone of aerial photographs whose purpose is to eliminate distortions caused by the nonuniformity of the lens illumination distribution function. A block diagram for the correction program on the EC-1022 computer is presented. The method can be used at the first stage of the machine processing of aerial photographic images. B.J.

A81-41484 # **The use of the spectral and physical-geographic characteristics of natural objects for the interpretation of multispectral satellite images (Ispol'zovanie spektral'nykh i fiziko-geograficheskikh kharakteristik prirodnykh obrazovanii pri deshifrirovanii mnogozonal'nykh sputnikovykh izobrazhenii).** N. K. Vinnichenko. In: Some results on the investigation of earth resources by aerial and polygon methods. Leningrad, Gidrometeoizdat, 1980, p. 45-50. In Russian.

Various aspects of the thematic interpretation of multispectral satellite images on the basis of the spectral and physical-geographic characteristics of natural objects on the earth's surface are considered. A block diagram describing the use of a priori information for the analysis of multispectral satellite images is presented. B.J.

A81-42555 # **Determination of the external-orientation elements of single photographs and stereopairs (Opredelenie elementov vneshnego orientirovaniia odinochnykh snimkov i stereopar).** I. T. Antipov (Nauchno-Issledovatel'skii Institut Prikladnoi Geodezii, USSR) and T. A. Bashkova. *Geodeziia i Aerofotos'emka,* vol. 1, 1981, p. 87-94. In Russian.

The paper formulates principles for the determination of the external-orientation elements (EOE) of single aerial photographs and stereopairs for their use in photogrammetry. A system of normal equations is developed for transformation to the inclined plane at all photograph points; the solution of these equations makes it possible to obtain quantities that characterize the position of the inclined plane. The EOEs of a photograph are determined from these quantities. A method is proposed for EOE determination in the processing of aerial photographs by analog steroephotogrammetry. B.J.

A81-42631 **A measure of reliability for classification of earth satellite data.** M. Alvo and M. Goldberg (Ottawa, University, Ottawa, Canada). *IEEE Transactions on Systems, Man, and Cybernetics,* vol. SMC-11, Apr. 1981, p. 312-318. 13 refs.

A measure is presented which may be used to indicate reliability or confidence in the classification of individual Landsat imagery pixels; in turn permitting comparisons, on an individual pixel basis, of classifications obtained from successive images. The immediate neighborhood in spectral space of each vector value of the class is compared with that of the modal vector by means of a modified chi-square goodness-of-fit statistic. A normalization technique based on simultaneous interference, which requires only the specification of a significance level (the usual alpha in statistics) is described, and the satisfactory performance of the measures is demonstrated through both simulated data and Landsat imagery. O.C.

A81-43185 **The GOES data collection system.** M. L. Nelson (NOAA, National Environmental Satellite Service, Washing-

ton, DC). In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979. Minneapolis, MN, American Water Resources Association, 1981, p. 45-47.

A brief look at the Geostationary Operational Environmental Satellite (GOES) Data Collection System (DCS) is provided. The basic configuration of the system is identified by describing the major elements and their functions. The basic design criteria, together with system development has led to a truly operational program. The National Environmental Satellite Service (NESS) and many users have accumulated years of experience with this program so that it is now possible to identify the useful features. This background also has made it possible for NESS and the users to plan for additional capabilities. System improvements and how they benefit the users are explained. Finally, the growth of the system in terms of number of platforms and users are given. (Author)

A81-43189 U.S. geological survey application of satellite telemetry for the support of hydrologic data collection. W. G. Shope and R. W. Paulson (U.S. Geological Survey, Reston, VA). In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979. Minneapolis, MN, American Water Resources Association, 1981, p. 60-64.

The network of hydrologic stations operated by the Geological Survey's Water Resources Division is discussed. Attention is given to the idea of using a satellite data collection system in order to automate the link between the field site sensor and the computer networks. It is noted that this automation would not only save manpower but would also shorten the collection cycle from weeks or months to hours. The satellite system comprises a satellite in orbit, a network of small battery-operated radio transmitters (called Data Collection Platforms, or DCP's), and one or more earth receiving stations. It is noted that monitoring the networks through the use of real-time data provides the Geological Survey with a valuable operational tool that will result in better quality data and greater efficiencies in network management. C.R.

A81-43222 Characteristics of microwave emission of significance to satellite remote sensing of soil water. R. W. Newton (Texas A & M. University, College Station, TX). In: Satellite Hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979. Minneapolis, MN, American Water Resources Association, 1981, p. 353-362. 18 refs.

Newton (1977) developed a method of interpreting passive microwave emission measurements in terms of average soil moisture over a predicted soil depth. In order to test the approach for a relatively wide range of soil water and soil temperature profile shapes, an analytical model is used to predict the microwave emission at four frequencies of soil water and soil temperature profiles measured by Jackson (1973) over a soil moisture range from saturation through dry down as well as at both day and night periods. It was determined that the average soil water parameter developed by Newton and its associated depth could be estimated from microwave emission measurements within a minimum of ambiguity. It was also found that the depth associated with the average soil water parameter is only slightly dependent on the soil temperature profile, which indicates that an improvement in depth of penetration will probably not be obtained from night measurements. B.J.

A81-43531 Correlation techniques and devices. G. Konecny and D. Pape (Hannover, Universität, Hanover, West Germany). *(International Society for Photogrammetry, Congress, 14th, Hamburg, West Germany, July 13-25, 1980.) Photogrammetric Engineering and Remote Sensing*, vol. 47, Mar. 1981, p. 323-333. 69 refs.

Image correlation techniques are reviewed according to the photogrammetric and mathematical fundamentals as well as the techniques for video-conversion, correlation, and rectification of video signals. The historical development of automatic image correlation devices from the Hobrough Stereomat, via the Bunker Ramo UNAMACE to the Hobrough Gestalt System and the Bendix AS-11-BX is then traced. Reference is made to the Rastar Correlator under development at the University of Hannover, based on designs by Hobrough and completed by Pape. Finally, other experimental attempts at image correlation, such as (coherent) optical correlation and digital off-line correlation, are summarized. (Author)

A81-43532 Automation in photogrammetry. J. B. Case (U.S. Defense Mapping Agency, Washington, DC). *(International Society for Photogrammetry, Congress, 14th, Hamburg, West Germany, July 13-25, 1980.) Photogrammetric Engineering and Remote Sensing*, vol. 47, Mar. 1981, p. 335-341. 39 refs.

All functional aspects of photogrammetry, i.e., triangulation mensuration, elevation data extraction, planimetric data extraction, and rectification and orthorectification, are now being automated to some degree. Automation extends from computer control of comparators and analog stereo plotters, through the analytical stereoplotters, to orthophoto printers and fully automated correlation equipment. The drive towards automation has been triggered not only by the continuing necessity to reduce costs, but also by the need to generate new products (e.g., DTM, land use, etc.) and to utilize other than conventional mapping photography. These have led, in turn, to the necessity for data editing and data management systems. The trend in the future will be towards the ever-increasing use of digital image processing technology. Examples of several levels of automation in photogrammetry are described. (Author)

A81-43546 A capture-recapture approach for estimation of detection probabilities in aerial surveys. L. D. Maxim (Everest Consulting Associates, Princeton, NJ), L. Harrington (Mathtech, Inc., Arlington, VA), and M. Kennedy. *Photogrammetric Engineering and Remote Sensing*, vol. 47, June 1981, p. 779-788. 17 refs.

A simple approach for estimating detection probabilities from imagery when ground truth data are non-existent is presented. Based upon what are termed capture-recapture statistics, the method requires only an independent examination of the imagery by two or more observers. In its simplest form the approach requires the assumptions that detections are independent and that no false positives occur. When data from three or more observers are available, checks upon model assumptions can be performed and less restrictive models can be developed. The approach is illustrated with several numerical examples. (Author)

A81-43734 * Training site statistics from Landsat and Seasat satellite imagery registered to a common map base. J. Clark (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA). In: Rainbow 80; Fall Technical Meeting, Niagara Falls, NY, October 7-10, 1980, ASP Technical Papers. Falls Church, VA, American Society of Photogrammetry, 1981, p. RS-1-F-1 to RS-1-F-9. 5 refs. Contract No. NAS7-100.

Landsat and Seasat satellite imagery and training site boundary coordinates were registered to a common Universal Transverse Mercator map base in the Newport Beach area of Orange County, California. The purpose was to establish a spatially-registered, multi-sensor data base which would test the use of Seasat synthetic aperture radar imagery to improve spectral separability of channels used for land use classification of an urban area. Digital image processing techniques originally developed for the digital mosaics of the California Desert and the State of Arizona were adapted to spatially register multispectral and radar data. Techniques included control point selection from imagery and USGS topographic quadrangle maps, control point cataloguing with the Image Based Information System, and spatial and spectral rectifications of the imagery. The radar imagery was pre-processed to reduce its tendency toward uniform data distributions, so that training site statistics for selected Landsat and pre-processed Seasat imagery indicated good spectral separation between channels. (Author)

A81-43736 On the analysis of remote sensing data to predict selected vegetative variables. R. K. Blystone and M. J. Duggin (New York, State University, Syracuse, NY). In: Rainbow 80; Fall Technical Meeting, Niagara Falls, NY, October 7-10, 1980, ASP Technical Papers. Falls Church, VA, American Society of Photogrammetry, 1981, p. RS-2-B-1 to RS-2-B-11. 17 refs. Research supported by the U.S. Department of Agriculture.

An empirical approach is used to predict biological variables from remote sensing data. The empirical use of an association as a predictor model when analyzing an image is shown to be dangerous,

since there may be many possible associations of remote sensing data with various biological variables. Moreover, use of ratios of recorded radiance values do not always work for a given situation. Approaches for formulating a better empirical predictor model, which would be applicable to a single image or limited ground area at one point in time are outlined. A regression model is constructed in which remotely sensed radiance values are the independent variables and the vegetative property of interest is the dependent variable. The necessity of constructing an economical multiple linear regression (MLR) model is discussed, and the importance of using training data to develop the MLR and test data for determining the adequacy of its predictions is explained. J.F.

A81-45431 A comparison between two photographic methods for the determination of relative bidirectional reflectance. P. J. Curran, T. J. Munday, and E. J. Milton (Reading, University, Reading, Berks., England). *International Journal of Remote Sensing*, vol. 2, Apr.-June 1981, p. 185-188. 5 refs. Research supported by the Natural Environment Research Council and University of Reading.

Two simple photographic methods have recently been proposed for the measurement of relative bidirectional reflectance (Lillesand and Kiefer 1979, Curran 1980). These two methods were used to calculate the relative bidirectional reflectance of ten contrasting surfaces. The photographic relative bidirectional reflectance so recorded, was then compared with the radiometric bidirectional reflectance for each surface. Two conclusions were drawn: first, that relative bidirectional reflectance can be measured using these simple photographic techniques, and second, that there was no significant difference between the Lillesand and Kiefer and Curran methods for photographically deriving relative bidirectional reflectance. (Author)

A81-45433 * Application of digital terrain data to quantify and reduce the topographic effect on Landsat data. C. O. Justice, S. W. Wharton, and B. N. Holben (NASA, Goddard Space Flight Center, Earth Resources Branch, Greenbelt, MD). *International Journal of Remote Sensing*, vol. 2, July-Sept. 1981, p. 213-230. 29 refs.

Landsat multispectral scanner (MSS) data are integrated with 30 m US Geological Survey digital terrain data to quantify and reduce topographic effects on imagery of a forested mountain ridge in central Pennsylvania. Spectral band ratioing slightly decreased variation of Landsat data for 50% of the transects and could not eliminate direct-light topographic effects. A Lambertian model increased topographic effect, and a modified Lambertian model decreased variation produced by the original model, but gave higher variances than found in the raw Landsat data. A non-Lambertian model, however, decreased variation by 86%, reducing topographic effects. The study demonstrated that high quality digital terrain data can be used to develop and test improved radiative transfer models, and enhance the utility of MSS data. D.L.G.

A81-46040 * Maximum likelihood estimation of label imperfection probabilities and its use in the identification of mislabeled patterns. C. B. Chittineni (Lockheed Engineering and Management Services Co., Houston, TX). In: Machine processing of remotely sensed data and soil information systems and remote sensing and soil survey; Proceedings of the Sixth Annual Symposium, West Lafayette, IN, June 3-6, 1980. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 158-170. 18 refs. Contract No. NAS9-15800.

Estimating label imperfections and the use of estimations in the identification of mislabeled patterns are discussed. Expressions are presented for the asymptotic variances of the probability of correct classification and proportion, and for the maximum likelihood estimates of classification errors and a priori probabilities. Models are developed for imperfections in the labels and classification errors, and expressions are derived for the probability of imperfect label identification schemes resulting in wrong decisions. The expressions are used in computing thresholds and the techniques are given practical applications. The imperfect label identification scheme in the multiclass case is found to amount to establishing a region around each decision surface, and decisions of the label correction scheme are found in close agreement with the analyst-interpreter interpretations of the imagery films. As an example, the application of the maximum likelihood estimation to the processing of Landsat MSS data is discussed. D.L.G.

A81-46041 * Context distribution estimation for contextual classification of multispectral image data. J. C. Tilton, P. H. Swain, and S. B. Vardeman (Purdue University, West Lafayette, IN). In: Machine processing of remotely sensed data and soil information systems and remote sensing and soil survey; Proceedings of the Sixth Annual Symposium, West Lafayette, IN, June 3-6, 1980. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 171-180. NSF Grant No. MCS-78-04366; Contract No. NAS9-15466.

A classification algorithm incorporating contextual information in a general, statistical manner is presented. Methods are investigated for obtaining adequate estimates of the context distribution (a statistical characterization of context) upon which the classification algorithm depends. Finally, a method of estimating optimal algorithm parameters prior to performing preliminary classifications is explored. (Author)

A81-46042 Stratification of Landsat data by uniformity productivity of soils. J. Schubert, P. Chagarlamudi (Deloitte, Haskins and Sells Associates, Ottawa, Canada), J. A. Shields, and A. R. Mack (Agriculture Canada, Land Resource Research Institute, Ottawa, Canada). In: Machine processing of remotely sensed data and soil information systems and remote sensing and soil survey; Proceedings of the Sixth Annual Symposium, West Lafayette, IN, June 3-6, 1980. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 186-194. 11 refs.

The goal of this study was to develop and verify methods to use Landsat data for mapping and quantifying the productivity of soil areas on which the annual yields of spring wheat exposed to the same weather conditions are generally different. The study was done in two parts. First, a calibration study was done to determine which features visible on Landsat imagery were associated with different relative productivities. Then, in a two-part accuracy verification study, Uniform Productivity Area (UPA) boundaries were drawn on three map sheets (1:250,000 Canadian National Topographic System) and the relative productivity of each UPA within 25 townships in the Canadian Prairies were estimated. The boundaries were compared with known soil productivity area boundaries and the relative productivity ratings were compared with reported yields. (Author)

A81-46043 Interactive processing of Landsat image for morphopedological studies. D. Chaume and N. P. Thien (IBM France, S.A., Paris, France). In: Machine processing of remotely sensed data and soil information systems and remote sensing and soil survey; Proceedings of the Sixth Annual Symposium, West Lafayette, IN, June 3-6, 1980. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 195-204. 5 refs.

A study of the Gale area of the Mandingue plateau was studied by means of the ERMAN II earth resources management system and a novel, interactive image processing system. Training fields belonging to the different morphopedological units were determined from four photographs of the study area, and a model of transformation between corresponding coordinates on images and photographs was calculated from a set of landmarks. The coordinates of the subimages were obtained by applying the model of transformation to the coordinates on the photographs. Separate models of deformation were in addition calculated for smaller areas, corresponding to each aerial photograph. O.C.

A81-46052 * # Inventory estimation on the massively parallel processor. P. D. Argentiero, J. P. Strong, and D. W. Koch (NASA, Goddard Space Flight Center, Greenbelt, MD). In: Machine processing of remotely sensed data and soil information systems and remote sensing and soil survey; Proceedings of the Sixth Annual Symposium, West Lafayette, IN, June 3-6, 1980. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 286-293. 6 refs.

This paper describes algorithms for efficiently computing inventory estimates from satellite based images. The algorithms incorporate a one dimensional feature extraction which optimizes the pairwise sum of Fisher distances. Biases are eliminated with a premultiplication by the inverse of the analytically derived error matrix. The technique is demonstrated with a numerical example using statistics obtained from an actual Landsat scene. Attention was given to implementation of the Massively Parallel processor (MPP). A timing analysis demonstrates that the inventory estimation can be

performed an order of magnitude faster on the MPP than on a conventional serial machine. (Author)

A81-46192 Simulation of orbital image-sensor geometry. R. B. Forrest. *Photogrammetric Engineering and Remote Sensing,* vol. 47, Aug. 1981, p. 1187-1193. 5 refs.

The essential dynamic aspects of orbital image-sensor geometry are modeled in a FORTRAN computer program presented and described in the paper. Parameters are listed for the Landsat MSS, and the program is sufficiently versatile that it can be modified to simulate other image-sensor geometries and formats. The program is organized to provide earth-surface coordinate outputs (latitude/longitude, local Cartesian) for any number of image coordinate inputs (pixel row/column numbers). Individual terrain heights may be specified for each image point of interest. (Author)

A81-46197 Alternative 'scale up' estimators for aerial surveys where both detection and classification errors exist. L. D. Maxim (Everest Consulting Associates, Princeton Junction, NJ), L. Harrington (Mathtech, Rosslyn, VA), and M. Kennedy. *Photogrammetric Engineering and Remote Sensing,* vol. 47, Aug. 1981, p. 1227-1239. 16 refs.

Four statistical estimators are proposed, characterized, and illustrated in order to scale up observed aerial survey counts of objects, for cases when both detection and classification errors are present. The context of the study is for an individual image or frame, and matrix methods are used for extensions to related aspects of the sampling theory. The model presented considers detection and classification as a two-stage process. Partial ground truth enables efficient estimators to be constructed or it can be used in place of either detection or identification probabilities. Of the four numerical examples presented, three make use of partial ground truth. Results may be used in agriculture and in the study of environmental pollutants. K.S.

A81-46378 * Correlation function studies for snow and ice. F. Vallese and J. A. Kong (MIT, Cambridge, MA). *Journal of Applied Physics,* vol. 52, Aug. 1981, p. 4921-4925. 13 refs. Research supported by the Charles Stark Draper Laboratory; Grant No. NAG5-141; Contract No. F19628-80-C-0052.

The random medium model is used to characterize snow and ice fields in the interpretation of active and passive microwave remote sensing data. A correlation function is used to describe the random permittivity fluctuations with the associated mean and variance and correlation lengths; and several samples are investigated to determine typical correlation functions for snow and ice. It is shown that correlation functions are extracted directly from appropriate ground truth data, and an exponential correlation function is observed for snow and ice with lengths corresponding to the actual size of ice particles or air bubbles. Thus, given that a medium has spatially stationary statistics and a small medium, the random medium model can interpret remote sensing data where theoretical parameters correspond to actual physical parameters of the terrain. D.L.G.

A81-46402 * Radiometry with nighttime DMSP images in digital form. T. A. Croft (SRI International, Menlo Park, CA). *Photogrammetric Engineering and Remote Sensing,* vol. 47, Sept. 1981, p. 1319-1325. 10 refs. NASA-supported research.

The USAF Defense Meteorological Satellite Program (DMSP) spacecraft sends images to earth in the form of numbers. It has been common practice to erase the only digital records, the magnetic tapes, for reuse, after films (resembling photographs) have been created from the numbers. While the DMSP images have been widely used, their application in research has been hindered by both the lack of digital data and the lack of an authoritative source of related technical information. The character of the digital form is considered. Each image is essentially a three-dimensional list (X,Y,Z) in which X and Y represent the position coordinates of a pixel and Z is its associated radiance. Only the value of Z is given and the X-Y position must be deduced from adjunct information. Each original scan composed of 1464 pixels represents an area on the earth's surface about 3 km wide and 3000 km long. Strengths and weaknesses of the system with respect to research applications are considered, and concepts for the design of a nocturnal imager are discussed. G.R.

A81-46917 # Large-area histograms from Meteosat images. K. O. Röska (ESA, European Space Operations Centre, Darmstadt, West Germany). *ESA Bulletin,* no. 27, Aug. 1981, p. 13-15.

The possibility of building multidimensional histograms from multichannel Meteosat images that improve feature identification and interpretation capabilities is demonstrated. Two-dimensional *histograms of large and meteorologically uniform areas are given as* examples, together with an automatic feature identification technique having modest computational requirements. The two histogram types produced by the method are infrared/visible and infrared/water vapor. O.C.

A81-47007 # Angular anisotropy of reflection from various types of underlying surface. I - Snow cover. II - Desert (Uglovaia anizotropiia otrazheniia razlichnykh tipov podstilaiushchei poverkhnosti. I - Snezhnyi pokrov. II - Pustynia). V. I. Korzov and K. Ia. Kondrat'ev. In: Radiation studies in the atmosphere.

Leningrad, Gidrometeoizdat, 1980, p. 43-63. 14 refs. In Russian.

Aerial measurements of the angular anisotropy of reflection of short-wave radiation from snow cover were performed with instruments aboard the IL-18 aircraft. Measurements of relative spectral brightness and spectral albedo are used to calculate coefficients of brightness, anisotropy of reflection, and asymmetry of reflection in the solar-vertical plane. These characteristics were used to analyze the angular anisotropy of reflection from snow cover as a function of solar height, flight altitude, angles of sight, and wavelength. Aerial measurements of the angular anisotropy of reflection from desert regions are also analyzed. Coefficients of brightness, anisotropy of reflection, and asymmetry in the solar-vertical plane are used to analyze the angular anisotropy of reflection from the desert as a function of wavelength, solar height, flight altitude, and angles of sight. F.G.M.

A81-47349 Use of elevation models for landform analysis by Seasat-SAR imagery. A. Apolloni (Calabira, Università, Cosenza, Italy), A. Carrara (CNR, IRPI, Cosenza, Italy), and P. Murino (Napoli, Università, Naples, Italy). *International Astronautical Federation, International Astronautical Congress, 32nd, Rome, Italy, Sept. 6-12, 1981, Paper 81-98.* 17 p. 35 refs.

Results are presented of a study of the feasibility of applying Seasat-SAR data to the identification and classification of slope instability phenomena. The study was carried out for the Buonamico Basin area of southern Calabria, a region characterized by rugged topography, strong relief, steep irregular slopes and a very dense stream network frequently subject to landslides and erosion. The imagery obtained was processed to remove radar speckle, then calibrated geometrically with reference to a digital terrain topographic map and calibrated radiometrically according to scattering area and direction. The resulting imagery is found to be strongly influenced by radar beam geometry, although the dominant landform features may be detected. On the basis of these results, it is recommended that (1) mountain zones be covered by at least two passes by an airborne or spaceborne system; (2) radiometric calibration be performed using properly smoothed digital terrain maps; and (3) radar data be compared with a large set of optically acquired and ground-based data. A.L.W.

A81-47351 Application of delta modulation in on-board and ground video data processing systems for the purposes of remote sensing. D. Mishev and P. Petrov (B'lgarska Akademiia na Naukite, Tsentralna Laboratoriia po Kosmicheski Izsledvaniia, Sofia, Bulgaria). *International Astronautical Federation, International Astronautical Congress, 32nd, Rome, Italy, Sept. 6-12, 1981, Paper 81-102.* 18 p. 8 refs.

The possibilities of delta modulation in the processing of multispectral video-data for remote sensing are discussed. It is noted that delta modulation allows the development of flexible digit systems for express analysis of a considerable amount of video data in a real time scale. Certain space-invariant operations and scale transformations are shown in data processing systems using delta modulation. The natural features of the method are analyzed for the case of differential and gradient operations over multispectral images. On the basis of this method, an efficient computational procedure of comparison with a reference pattern is developed. The possibilities of delta modulation in express video-processing ground systems are demonstrated by means of specialized devices operating in real time,

for example, the analyzer of multispectral homogeneities. An on-board system for data acquisition and data processing based on delta modulation is described. C.R.

A81-47352 Image quality for SPOT satellite - Specifications and budget. G. Begni (Centre National d'Etudes Spatiales, Paris, France). *International Astronautical Federation, International Astronautical Congress, 32nd, Rome, Italy, Sept. 6-12, 1981, Paper 81-104.* 12 p.

The SPOT satellite, based on the CCD detector arrays, is to provide high resolution images of the earth surface in the visible and near-infrared domain as well as allow nadir viewing. The data products delivered by the ground image segment of the SPOT satellite program will be distributed over three levels in accordance with required accuracy. The products are rated on their radiometric and geometrical qualities: the radiometric image quality is the restitution accuracy of the measurement made by the satellite; its specifications lie in the accuracy of the signal to noise ratio, linearity, the relative accuracy between spectral bands, the relative multitemporal accuracy, the absolute accuracy, and the transfer function. Specifications of the geometrical image quality usually apply to vertical viewings and scenes with restricted altitude variations: localization accuracy, changes in lengths, anisomorphism, local cohérence, multispectral superimposability, and relief restitution. J.F.

A81-48473 Image correlation algorithms. B. Makarovic (International Institute for Aerial Survey and Earth Sciences, Enschede, Netherlands). *ITC Journal,* no. 1, 1981, p. 32-59. 25 refs.

Concepts and techniques for image correlation in photogrammetry are reviewed. The discussion includes the definition of image correlation systems, a classification of the various approaches, a brief description of the basic operations involved and their modifications, identification of the problem areas and possible solutions, and an estimate of the development trends. Image correlation is considered in the context of automatic generation of x-(or epipolar) parallaxes. V.L.

A81-48552 Radar-optical-topographic transformations for scene content analysis. C. A. McPherson, J. J. Hwang, and E. L. Hall (Tennessee, University, Knoxville, TN). In: EASCON '80; Electronics and Aerospace Systems Conference, Arlington, VA, September 29-October 1, 1980, Conference Record. New York, Institute of Electrical and Electronics Engineers, 1980, p. 355-359. 6 refs. Contract No. F07401-78-C-0193.

A general method for transformations from one image to another is described and demonstrated for a typical radar-optical-topographic scene. The technique requires no visual correlation of pixels, although a knowledge of the position and orientation of the radar imaging system is needed. The theoretical concept of optical to radar transformation is explained through a mathematical model of the process, which derives a set of equations from six radar and three optical reference pixels. The technique is implemented by locating the position and orientation information of the chosen radar scene from previously generated data files, and selecting the region of the aerial photography that is assumed to contain the radar image. An error analysis is made, and the calculation error is reduced through software and visual inspection. Due to the ease of use and versatility of the technique, it requires less time than those methods which require a visual correlation of pixels within the two scenes, and is applicable to other types of scene matching. D.L.G.

A81-48693 # Selection of reference zones for the automatic coordinate control of space images (Vybor opornykh uchastkov dlia avtomaticheskoi koordinatnoi priviazki kosmicheskoi videoinformatsii). G. A. Avanesov, V. A. Vavaev, and V. E. Verbin (Akademiia Nauk SSSR, Institut Kosmicheskikh Issledovanii, Moscow, USSR). *Issledovanie Zemli iz Kosmosa,* July-Aug. 1981, p. 91-95. 16 refs. In Russian.

Initial prerequisites and experimental data are presented, concerning an approach for selecting the reference zones for the automation of the coordinate control of images of the earth's surface, using data from space imagery systems. Based on the analysis of experimental results using actual images, a conclusion is made about the possible volume of an automatic catalog of standard reference zones. The main aspects of the method for selecting reference zones on the earth's surface include: (1) scanning and contouring on images of characteristic zones, satisfying geographical and physical requirements; (2) selecting the spectral range to describe the standard reference zones; (3) selecting the reference zones from contour zones on images, satisfying the maximum criterion for the parameter of nonuniformity; and (4) studying the temporal instability of the reference zones and determining the possible periods of dynamic correction of standards. J.F.

A81-48694 # Geometric correction of scanner images of the earth's surface (K voprosu o geometricheskoi korrektsii skanernykh snimkov zemnoi poverkhnosti). V. I. Khizhnichenko. *Issledovanie Zemli iz Kosmosa,* July-Aug. 1981, p. 96-103. 7 refs. In Russian.

Space images of the earth, obtained from on-board TV scanning systems, are subject to geometric distortions, caused by a number of factors. The correction of these distortions is accomplished by computer, and the processing algorithms are developed for maximum speed to meet operational requirements. Expressions are obtained for recalculation of the coordinates of pixels, accomplished during the correction process, based on a mathematical model of scanner image acquisition. Examples of the processing of actual images of the earth's surface using the algorithms are presented. J.F.

A81-48772 # Derivation of formulas for the correlation of coordinate points of different-scale photographs and quasi-photographs (Vyvod formul sootnosheniia koordinat tochek raznomasshtabnykh fotosnimkov i kvazisnimkov). M. V. Shul'min. *Geodeziia i Aerofotos'emka,* no. 3, 1981, p. 55-60. In Russian.

Formulas are derived that correlate the coordinate points of a place depicted on different-scale photographs obtained by aerial cameras with different focal distances and on processed photographs (so-called quasi-photographs). Electronic stereoscopic equipment has been developed for the image transformation of the different-scale photographs; this equipment makes it possible to transform photographic signals into electrical video signals on the basis of the mathematical relationships that have been derived. The application of this method of stereotopographic cartography is discussed. B.J.

A81-48773 # The influence of the accuracy of determining the elements of the external orientation of a stereopair on the processing of aerial photographs on the basis of adjusting elements (Vliianie tochnosti opredeleniia elementov vneshnego orientirovaniia stereopary na protsess obrabotki aerosnimkov po ustanovochnym elementam). T. A. Bashkova. *Geodeziia i Aerofotos'emka,* no. 3, 1981, p. 67-73. In Russian.

The paper investigates a method for determining the external-orientation elements of stereopairs by means of double photogrammetric resection. Attention is given to the influence of mean square errors in the external-orientation elements on the accuracy of computation of adjusting elements for scales of stereophotogrammetric devices and coordinate points. B.J.

A81-48943 A practical method for the verification of computer-processed Landsat data. J. Hadley, Jr. (Northeast Ohio Four-County Regional Planning and Development Organization, Akron, OH) and T. L. Nash (Akron, University, Akron, OH). *Remote Sensing Quarterly,* vol. 3, Jan. 1981, p. 29-37. 9 refs. Research supported by the University of Akron.

A data verification technique is presented which can be adapted for use at most map scales and is relatively inexpensive, efficient, and requires a minimum of staff training. The technique is presented in the context of a study designed to test the reliability of processed LANDSAT cover data for Ohio for three distinct physiographic areas of the state. It is found to be adequate for generating the data's accuracy of statistics. It is noted that the methodology can be replicated for use with other polygon or grid cell geocoded information systems by altering, if necessary, the cell size used for pixel alignment. C.R.

A81-49345 * ICAP - An Interactive Cluster Analysis Procedure for analyzing remotely sensed data. S. W. Wharton (NASA, Goddard Space Flight Center, Earth Resources Branch, Greenbelt, MD) and B. J. Turner (Pennsylvania State University, University Park, PA). *Remote Sensing of Environment,* vol. 11, Sept. 1981, p. 279-293. 30 refs.

An Interactive Cluster Analysis Procedure (ICAP) was developed to derive classifier training statistics from remotely sensed data. ICAP

differs from conventional clustering algorithms by allowing the analyst to optimize the cluster configuration by inspection, rather than by manipulating process parameters. Control of the clustering process alternates between the algorithm, which creates new centroids and forms clusters, and the analyst, who can evaluate and elect to modify the cluster structure. Clusters can be deleted, or lumped together pairwise, or new centroids can be added. A summary of the cluster statistics can be requested to facilitate cluster manipulation. The principal advantage of this approach is that it allows prior information (when available) to be used directly in the analysis, since the analyst interacts with ICAP in a straightforward manner, using basic terms with which he is more likely to be familiar. Results from testing ICAP showed that an informed use of ICAP can improve classification, as compared to an existing cluster analysis procedure. (Author)

A81-49768 # **An investigation of the autocorrelation function of radar images.** L. Alexander (General Electric Co., Space Div., Philadelphia, PA) and H. Kritikos (Pennsylvania, University, Philadelphia, PA). In: Canadian Symposium on Remote Sensing, 6th, Halifax, Canada, May 21-23, 1980, Proceedings.
Ottawa, Canadian Aeronautics and Space Institute, 1981, p. 153-160. 12 refs.

Three digital radar data sets are examined and their autocorrelation functions are computed. The autocorrelation functions are found to be substantially lower than those of visible images. The effects of resampling on imagery with this lower correlation coefficient are examined. The implication of these findings for information extraction from radar images is that spatial properties contribute a significant amount of information to classification success. The implication of the result for data compression suggests the improved performance of the Even Discrete Sine Transform for the compression of radar imagery. B.J.

A81-49780 # **Cartographic accuracy of synthetic aperture radar imagery.** E. E. Derenyi and L. Szabo (New Brunswick, University, Fredericton, Canada). In: Canadian Symposium on Remote Sensing, 6th, Halifax, Canada, May 21-23, 1980, Proceedings. Ottawa, Canadian Aeronautics and Space Institute, 1981, p. 287, 288. Research supported by the Department of Energy, Mines and Resources of Canada.

The cartographic accuracy of microwave imagery is investigated to ascertain geometric characteristics of imagery recorded by a synthetic aperture radar installed in the Convair-580 aircraft. Imagery is acquired in three passes, each line approximately 60 km long, with a sensor operating in a shallow angle mode at a depression angle of 24.4 deg to the center of the beam. Accuracy of the geographic position of points from SAR imagery is found to be a function of the density of control points and the length of the strip, and it is concluded that SAR-850 imagery has potential as a source of information for the revision of 1:50,000 scale maps when mathematical transformation and digital mapping techniques are employed. D.L.G.

A81-49793 # **Digital enhancements for vegetation mapping in a subarctic environment.** I. L. Johnston and P. J. Howarth (McMaster University, Hamilton, Ontario, Canada). In: Canadian Symposium on Remote Sensing, 6th, Halifax, Canada, May 21-23, 1980, Proceedings. Ottawa, Canadian Aeronautics and Space Institute, 1981, p. 405-412. 17 refs. Research supported by McMaster University; Natural Sciences and Engineering Research Council of Canada Grant No. A-5586.

Experiments have been undertaken to determine the most appropriate digital Landsat enhancements for mapping subarctic vegetation. Landsat data of the Hook Point area in northern Ontario recorded in June, July, and September were used in the study. Linear contrast stretch, band ratioing, video filtering and principal components enhancements were applied to the data. A visual assessment of the results was made to determine the capabilities of each enhancement to differentiate bog, fen and transitional vegetation cover. The effect of the enhancement algorithms on the digital values was also studied in small test areas. The different color renditions between a standard color composite and an atmospherically corrected composite demonstrate the effects of the solar and atmospheric corrections. The linear contrast stretch provided more vegetation information than the composites. However, band ratioing, video filtering and principal components enhancements did not provide satisfactory images of the vegetation. B.J.

A81-49795 # **Computer analysis of Tiros-N/NOAA-6 satellite data for operational snow cover mapping.** S. E. Waterman, W. D. Hogg, A. J. Hanssen, and V. L. Polavarapu (Department of the Environment, Atmospheric Environment Service, Downsview, Ontario, Canada). In: Canadian Symposium on Remote Sensing, 6th, Halifax, Canada, May 21-23, 1980, Proceedings.
Ottawa, Canadian Aeronautics and Space Institute, 1981, p. 435-442. 11 refs.

A81-49804 * # **Investigation of multispectral remote sensing of snow cover using a solar radiation model.** S. E. Waterman (Department of the Environment, Atmospheric Environment Service, Downsview, Ontario, Canada). In: Canadian Symposium on Remote Sensing, 6th, Halifax, Canada, May 21-23, 1980, Proceedings. Ottawa, Canadian Aeronautics and Space Institute, 1981, p. 525-540. 29 refs. Grant No. NGL-06-003-200.

A solar radiation model is described which is able to calculate, for given atmospheric and topographic input conditions, the spectral distributions of the direct and diffuse components of the total irradiance incident upon a target surface. The irradiance includes both upwelling radiation backscattered toward the earth's surface and radiation reflected toward the target from other terrain surfaces. Spectral reflectance data for two dissimilar snow types are fed into the model, along with a geometric description of the topography of the snow covered terrain. These data permit the calculation of the exitance of the target over the wavelength limits of a given sensor and, hence, the apparent contrast between the two snow types for the given input conditions. The results show that the contrast between the two snow types, all other factors being constant, is greatest in the near infrared wavelengths. C.R.

A81-49808 # **Role of aerial photographs in classification of Landsat data.** W. A. Miller, G. R. Johnson (Technicolor Graphic Services, Inc., Sioux Falls, SD), and W. G. Rhode. In: Canadian Symposium on Remote Sensing, 6th, Halifax, Canada, May 21-23, 1980, Proceedings. Ottawa, Canadian Aeronautics and Space Institute, 1981, p. 575, 576. 5 refs.

A81-49812 # **Histogram estimation for multiple-detector sensors.** W. M. Strome (Canada Centre for Remote Sensing, Ottawa, Canada). In: Canadian Symposium on Remote Sensing, 6th, Halifax, Canada, May 21-23, 1980, Proceedings. Ottawa, Canadian Aeronautics and Space Institute, 1981, p. 603-608.

It is shown that with relatively minor modification, peak and valley seeking clustering algorithms can be made more effective by adjusting the histograms of radiometrically corrected multidetector per channel data, such as those from the Landsat MSS as described. The slightly more complicated procedure produces a histogram which much more closely approximates the original intensity probability distribution function than that of either the raw or radiometrically corrected data. C.R.

A81-49813 # **Comparative experimental study on the use of original and compressed multispectral Landsat data of the Bayuda desert.** K. A. Ulbricht (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für Nachrichtentechnik, Oberpfaffenhofen, West Germany). In: Canadian Symposium on Remote Sensing, 6th, Halifax, Canada, May 21-23, 1980, Proceedings. Ottawa, Canadian Aeronautics and Space Institute, 1981, p. 609-616. 5 refs.

An excerpt from a multispectral Landsat scene, compressed by a ratio of 6.4/1, is investigated to determine the effect of the compression on the image contents. The study is based on several years of image processing activities on Landsat scenes of North African territories, in particular the Landsat image of February 5, 1973, of the Bayuda desert in the Sudan. This image was submitted to supervised maximum likelihood classification before and after compression of data as a function of the rejection class parameter sigma. Different approaches to the use of circular or rectangular training areas, before and after their compression, for classification on original and compressed scene, were used in investigating the influence of compression on image contents. With the aid of five training areas for classification, partitioning of classified image,

original as well as compressed, is given on a percentage basis as a function of sigma. C.R.

A81-49814 # **Acquisition and preprocessing of images collected by future European Space Agency satellites.** J.-P. Antikidis (ESA, Earth Observation Programme Office, Toulouse, France). In: Canadian Symposium on Remote Sensing, 6th, Halifax, Canada, May 21-23, 1980, Proceedings. Ottawa, Canadian Aeronautics and Space Institute, 1981, p. 617-624.

Various efforts planned by the European Space Agency (ESA) for the development of systems in which instruments and processing are defined as a whole are discussed. Analysis of the different requirements has led the Agency to envisage specific payloads that would allow objectives to be attained in land applications, coastal ocean monitoring, and global ocean monitoring. It is noted that the ERS-1 system will have a satellite consisting of a multimission platform equipped with an 1800 W solar generator and a Fine Attitude Measurement System; the payload will comprise an Ocean Color Monitor, a multichannel Imaging Microwave Radiometer, and a Synthetic Aperture Radar. C.R.

A81-49818 # **Geometric accuracy of Landsat images processed by NASDA.** Y. Yamamoto (National Space Development Agency of Japan, Tokyo, Japan). In: Canadian Symposium on Remote Sensing, 6th, Halifax, Canada, May 21-23, 1980, Proceedings. Ottawa, Canadian Aeronautics and Space Institute, 1981, p. 661-663.

N81-29497*# Lockheed Engineering and Management Services Co., Inc., Houston, Tex.
AN ANALYSIS OF HAZE EFFECTS ON LANDSAT MULTISPECTRAL SCANNER DATA
W. R. Johnson and M. L. Sestak, Principal Investigators Mar. 1981 40 p refs Sponsored by NASA, USDA, Dept. of Commerce, Dept. of the Interior, and Agency for International Development ERTS
(Contract NAS9-15800; Proj. AgRISTARS)
(E81-10162; NASA-CR-160984; SR-L1-04071; LEMSCO-15971; JSC-17127) Avail: NTIS HC A03/MF A01 CSCL 02C

Early season changes in optical depth change brightness, primarily along the soil line; and during crop development, changes in optical depth change both greenness and brightness. Thus, the existence of haze in the imagery could cause an unsuspecting analyst to interpret the spectral appearance as indicating an episodal event when, in fact, haze was present. The techniques for converting LANDSAT-3 data to simulate LANDSAT-2 data are in error. The yellowness and none such computations are affected primarily. Yellowness appears well correlated to optical depth. Experimental evidence with variable background and variable optical depth is needed, however. The variance of picture elements within a spring wheat field is related to its equivalent in optical depth changes caused by haze. This establishes the sensitivity of channel 1 (greenness) pixels to changes in haze levels. The between field picture element means and variances were determined for the spring wheat fields. This shows the variability of channel data on two specific dates, emphasizing that crop development can be influenced by many factors. The atmospheric correction program ATCOR reduces segment data from LANDSAT acquisitions to a common haze level and improves the results of analysis. A.R.H.

N81-29498*# Lockheed Engineering and Management Services Co., Inc., Houston, Tex.
THE MULTICATEGORY CASE OF THE SEQUENTIAL BAYESIAN PIXEL SELECTION AND ESTIMATION PROCEDURE
M. D. Pore and T. B. Dennis, Principal Investigators Nov. 1980 22 p refs Sponsored by NASA, USDA, Dept. of Commerce, Dept. of Interior, and Agency for International Development ERTS
(Contract NAS9-15800; Proj. AgRISTARS)
(E81-10182; NASA-CR-160965; SR-LO-00478; LEMSCO-14807; JSC-16378) Avail: NTIS HC A02/MF A01 CSCL 12A

A Bayesian technique for stratified proportion estimation and a sampling based on minimizing the mean squared error of this estimator were developed and tested on LANDSAT multispectral scanner data using the beta density function to model the prior distribution in the two-class case. An extention of this procedure to the k-class case is considered. A generalization of the beta function is shown to be a density function for the general case which allows the procedure to be extended. Author

N81-29501*# Lockheed Engineering and Management Services Co., Inc., Houston, Tex.
CONVERSION OF SPU-UNIVERSAL DISK FILE TO JSC-UNIVERSAL TAPE STORAGE: CONVRT USER'S GUIDE
W. E. Ryland, Principal Investigator Sep. 1980 12 p Sponsored by NASA, USDA, Dept. of Commerce, Dept. of Interior, and Agency for International Development ERTS
(Contract NAS9-15800; Proj. AgRISTARS)
(E81-10185; NASA-CR-160938; EW-LO-00706; LEMSCO-15608; JSC-16821) Avail: NTIS HC A02/MF A01 CSCL 09B

The CONVRT, program which runs on a DEC PDP 11/70 computer, reads data files on disk in the SPU-Universal format and reformats the data to JSC Universal and output on tape. A.R.H.

N81-29502*# Lockheed Engineering and Management Services Co., Inc., Houston, Tex.
MAXIMUM LIKELIHOOD CLUSTERING WITH DEPENDENT FEATURE TREES
C. B. Chittineni, Principal Investigator Jan. 1981 54 p refs Sponsored by NASA, USDA, Dept. of Commerce, Dept. of the Interior, and Agency for International Development ERTS
(Contract NAS9-15683; Proj. AgRISTARS)
(E81-10186; NASA-CR-160939; SR-L1-04031; LEMSCO-15683; JSC-16853) Avail: NTIS HC A04/MF A01 CSCL 12A

The decomposition of mixture density of the data into its normal component densities is considered. The densities are approximated with first order dependent feature trees using criteria of mutual information and distance measures. Expressions are presented for the criteria when the densities are Gaussian. By defining different types of nodes in a general dependent feature tree, maximum likelihood equations are developed for the estimation of parameters using fixed point iterations. The field structure of the data is also taken into account in developing maximum likelihood equations. Experimental results from the processing of remotely sensed multispectral scanner imagery data are included. A.R.H.

N81-29503*# Elogic, Inc., Houston, Tex.
NEW OUTPUT IMPROVEMENTS FOR CLASSY
M. E. Rassbach, Principal Investigator Mar. 1981 37 p Sponsored by NASA, USDA, Dept. of Commerce, Dept. of the Interior, and Agency for International Development ERTS
(Contract NAS9-15981; Proj. AgRISTARS)
(E81-10189; NASA-CR-160974; SR-XI-04053; NAS-811) Avail: NTIS HC A03/MF A01 CSCL 02C

Additional output data and formats for the CLASSY clustering algorithm were developed. Four such aids to the CLASSY user are described. These are: (1) statistical measures; (2) special map types; (3) formats for standard output; and (4) special cluster display method. A.R.H.

N81-29506*# National Oceanic and Atmospheric Administration, Houston, Tex.
CHARACTERISTICS, OF TIROS, GOES, DMSP AND LANDSAT SYSTEMS
T. I. Gray, Jr., D. G. McCrary, and T. A. Armstrong, Principal Investigators (Lockheed Engineering and Management Services Co., Inc., Houston, Tex.) Mar. 1981 21 p Sponsored by NASA, USDA, Dept. of Commerce, Dept. of the Interior, and Agency for International Development
(Proj. AgRISTARS)
(E81-10192; NASA-CR-160979; EW-N1-04075; JSC-17131) Avail: NTIS HC A02/MF A01 CSCL 02C

The characteristics of the TIROS, GOES, DMSP and LANDSAT systems of satellites are described. The data listed for each system are altitude of orbit, inclination/position, orbit type, orbits per day, expected operational lifetime and the sensor systems. The sensor systems are described as to wavelength of each channel, resolution, field of view and other pertinent information. Data information such as availability rate, collection method, primary use/application and how to obtain additional information is also given. Author

N81-29509*# Lockheed Engineering and Management Services Co., Inc., Houston, Tex.
COMPUTER PROGRAM DOCUMENTATION USER INFORMATION FOR THE RSO-TAPE PRINT PROGRAM (RSOPRNT)
P. M. Gibbs, Principal Investigator Nov. 1980 11 p ERTS
(Contract NAS9-15800)
(E81-10198; NASA-CR-161000; JSC-17015; LEMSCO-15903) Avail: NTIS HC A02/MF A01 CSCL 09B

A user's guide for the RSOPRNT, a TRASYS Master Restart Output Tape (RSO) reader is presented. Background information and sample runstreams, as well as, references, input requirements and options, are included. J.M.S.

N81-29510*# Lockheed Engineering and Management Services Co., Inc., Houston, Tex.
ESTIMATION OF PROPORTIONS IN MIXED PIXELS THROUGH THEIR REGION CHARACTERIZATION
C. B. Chittineni, Principal Investigator Mar. 1981 38 p refs
Sponsored by NASA, USDA, Dept. of Commerce, Dept. of the Interior, and Agency for International Development ERTS
(Contract NAS9-15800; Proj. AgRISTARS)
(E81-10199; NASA-CR-161001; SR-L1-04067; LEMSCO-16021; JSC-17124) Avail: NTIS HC A03/MF A01 CSCL 12A

A region of mixed pixels can be characterized through the probability density function of proportions of classes in the pixels. Using information from the spectral vectors of a given set of pixels from the mixed pixel region, expressions are developed for obtaining the maximum likelihood estimates of the parameters of probability density functions of proportions. The proportions of classes in the mixed pixels can then be estimated. If the mixed pixels contain objects of two classes, the computation can be reduced by transforming the spectral vectors using a transformation matrix that simultaneously diagonalizes the covariance matrices of the two classes. If the proportions of the classes of a set of mixed pixels from the region are given, then expressions are developed for obtaining the estmates of the parameters of the probability density function of the proportions of mixed pixels. Development of these expressions is based on the criterion of the minimum sum of squares of errors. Experimental results from the processing of remotely sensed agricultural multispectral imagery data are presented. A.R.H.

N81-29522# Itek Corp., Lexington, Mass. Optical Systems Div.
CONCEPTUAL DESIGN OF AN AUTOMATED MAPPING SATELLITE SYSTEM (MAPSAT) Final Technical Report
26 Mar. 1981 303 p refs
(Contract DI-14-08-0001-18656)
(PB81-185555; ITEK-81-8449A-2; USGS/NMD-81-001) Avail: NTIS HC A14/MF A01 CSCL 08B

A concept for mapping and monitoring the Earth's surface from space involves obtaining elevation data from the use of the epipolar-plane condition in space. This greatly simplifies the mapping problem by permitting the automated processing of stereo data into digital elevation data. Multicolored image maps at 1:50,000 scale with 20-m contours are indicative of the products which are within the capability of the Mapsat system. Mapsat would provide continuity with respect to LANDSATS 1-3, including the same basic data transmission system. GRA

N81-30499# General Electric Co., Lanham, Md. Space Div.
INTERACTIVE DIGITAL IMAGE PROCESSING FOR TERRAIN DATA EXTRACTION Interim Report, 18 Sep. 1979 - 17 Sep. 1980
Howard L. Heydt, Thomas F. Wescott, and Christopher J. Peterson Nov. 1980 181 p refs
(Contract DAAK70-79-C-0153)
(AD-A101321; ETL-0241) Avail: NTIS HC A09/MF A01 CSCL 09/2

Man-machine interactive digital image processing techniques were applied to the extraction of terrain analysis data from aerial imagery were investigated. Emphasis is given to the extraction of vegetation data elements from digitized panchromatic photograhy, with a small amount of attention given to thermal infrared and side-looking radar imagery. Vegetation data elements listed in the USAETL Terrain Analysis Procedural Guide for Vegetation are addressed in varying degrees of depth. Interactive digital techniques are developed for vegetation/land cover boundary extraction, and for the extraction of several forest related data elements. The extraction techniques are developed using an interactive digital image analysis system-the General Elecric DIAL (Digital Image Analysis Laboratory). Results are compared in two cases to those achieved via existing manual analysis procedures. Author (GRA)

N81-30723# Environmental Research Inst. of Michigan, Ann Arbor. Radar and Optics Div.
FOURIER MODULUS IMAGE CONSTRUCTION Final Technical Report, 7 Sep. 1979 - 30 Sep. 1980
James E. Fienup May 1981 70 p refs
(Contract F30602-80-C-0002)
(AD-A101728; RADC-TR-81-63) Avail: NTIS HC A04/MF A01 CSCL 04/1

This report describes the investigation of a new method for recovering diffraction-limited images through the turbulent atmosphere. It consists of an iterative algorithm that constructs an image from Fourier modulus data which is measured by stellar speckle interferometry. Research results indicate that the method has the potential for providing diffraction-limited images of Earth-orbiting satellites. Image construction experiments were performed on Fourier modulus data computer-simulated to include the effects of atmospheric turbulence, diffraction, photon (Poisson statistics) noise, and a finite number of short-exposure images. The quality of the constructed images was found to degrade in a gradual and predictable manner as the signal-to-noise ratio decreases. The rms error of the constructed images was found to vary approximately as the square root of the rms error of the Fourier modulus data. Diffraction-limited images were constructed for levels of photon noise that would be expected for imaging satellites through a 1.6-meter telescope. Image construction experiments were performed on the Fourier modulus of a number of different objects of varying complexity. Interpretation of the results was complicated by a tendency of the algorithm to stagnate at local minimum having the appearance of a good quality image superimposed by a pattern of stripes. Nevertheless, results were suggestive that the solution is usually unique. GRA

N81-30852# L N K Corp., Inc., Silver Spring, Md.
KNOWLEDGE-BASED IMAGE ANALYSIS Progress Report, 1 Sep. 1978 - 1 Dec. 1980
George C. Stockman, Barbara A. Lambird, David Lavine, and Laveen N. Kanal Apr. 1981 243 p refs
(Contract DAAK70-77-C-0110)
(AD-A101319; ETL-0258) Avail: NTIS HC A11/MF A01 CSCL 09/2

The work reported was directed toward employing a priori knowledge in the automatic analysis of aerial imagery. Major objectives of the research were directed toward (1) map-guided registration; (2) verification of geographic data bases extracted from imagery; (3) enrichment of geographic data bases; and (4) automatic terrain feature extraction using multiple sources of knowledge and multi-level decision making. The key component in all of the work was the matching of existing iconic structure in a geographic data base (GDB) with detected image structure. By using iconic knowledge, the image interpretation paradigm becomes a three step process. First, some primitive features of the imagery must be recognized without any area-specific knowledge. Second, the imagery is aligned or registered with the knowledge base by drawing correspondences between the image features and their iconic analogues in the GDB. The matching is formalized by derivation of a transformation which maps points (x,y) of the image to points (u,v) in GDB coordinates. The final step of the process is the analysis of those parts of the image which were not successfully interpreted in steps 1 and 2. This implies a top-down search for image structures which correspond to features in the GDB. Section 2 of the report treats primitive extraction. The emphasis is currently on lineal, point, and region features only. A method for automatically inferring a rotation and translation transforming image to map is given in Section 3. Classification of registered regions is discussed in Section 4. Verification of lineal GDB features in gray-scale imagery is introduced in Section 5. Author (GRA)

N81-31600*# Elogic, Inc., Houston, Tex.
IMPROVED VERSION OF THE SPLIT ROUTINE FOR CLASSY
M. E. Rassbach, Principal Investigator Mar. 1981 16 p
Sponsored by NASA, USDA, Dept. of Commerce, Dept. of the Interior, and Agency for International Development ERTS
(Contract NAS9-15981; Proj. AGRISTARS)

(E81-10210; NASA-CR-160973; SR-IX-04046) Avail: NTIS HC A02/MF A01 CSCL 02C

The theoretical basis for a new version of the SPLIT routine for CLASSY is developed. (The SPLIT routine is used to guess the positions of the parts of a cluster which is not normally distributed.) The proposed routine would be a faster, more accurate replacement for the existing SPLIT routine, which was developed on an ad hoc basis. J.M.S.

N81-31613# Royal Aircraft Establishment, Farnborough (England).

A TECHNIQUE FOR LINE EXTRACTION FROM LANDSAT MULTI-SPECTRAL SCANNER SATELLITE DATA WITH SOME APPLICATIONS OF THE TECHNIQUE

A. H. Benny Jan. 1981 42 p refs

(RAE-TR-81010; RAE-SPACE-592; BR78637) Avail: NTIS HC A03/MF A01

An automated technique is described for extracting lines from LANDSAT multispectral scanner images by means of density contour threading of the data. Lines are stored in the form of a series of X, Y coordinate pairs, sufficient coordinates being present to define each line with the required amount of detail. At a given contour level all possible lines are constructed which thread through the grid such that all locations to one side have a higher or similar value and all locations to the other side have a lower value. The image will in general yield several separate contour lines at any specified contour level. The method of searching for individual contour lines is based upon the observation that a line must run between any two adjacent pixels if one of them has a lower radiance value and the other a higher value than the selected level for the boundary line. If the selected level is the same as a pixel value, the line must run through that pixel, and to avoid missing this condition the test is altered to include the case in which one pixel has a lower value and the other a value greater than or equal to the selected level. Author (ESA)

N81-31615# National Oceanic and Atmospheric Administration, Washington, D. C. National Earth Satellite Service.

SATELLITE IDENTIFICATION OF SURFACE RADIANT TEMPERATURE FIELDS OF SUBPIXEL RESOLUTION

Jeff Dozier Dec. 1980 17 p refs Sponsored in part by National Academy of Sciences - National Research Council

(PB81-184038; NOAA-TM-NESS-113; NOAA-81021710) Avail: NTIS HC A02/MF A01 CSCL 04B

A method is presented for identifying from NOAA TIROS-N series satellite data the magnitudes and subpixel areal coverages of two different surface radiant temperatures. The method utilizes the different response of the Planck function at different wavelengths. GRA

N81-32602# National Oceanic and Atmospheric Administration, Boulder, Colo. Environmental Research Lab.

CATEGORIZATION OF NORTHERN GREEN BAY ICE COVER USING LANDSAT 1 DIGITAL DATA: A CASE STUDY

George A. Leshkevich Jan. 1981 25 p refs

(PB81-200438; NOAA-TM-ERL-GLERL-33; NOAA-81032301) Avail: NTIS HC A02/MF A01 CSCL 08I

Northern Green Bay ice cover on February 13, 1975, was analyzed using LANDSAT 1 digital data on the computer facilities at the Environmental Research Institute of Michigan. Training sets, consisting of selected areas in the LANDSAT scene that represent various ice types, were entered based upon the tone, texture, and location of the ice within the bay. The classification algorithm used in the analysis consisted of a modified maximum likelihood procedure using the multivariate Gaussian probability density function. It was found that seven ice types could be differentiated in the ice cover, that new (thin) ice could be distinguished from water, and that ice could be distinguished from relatively thin cloud cover. GRA

N81-33345# Canada Centre for Remote Sensing, Ottawa (Ontario).

WAVE ORBITAL VELOCITY, FADE AND SAR RESPONSE TO AZIMUTH WAVES

R. K. Raney *In* ESA Coherent and Incoherent Radar Scattering from Rough Surfaces and Vegetated Areas May 1981 p 63-70 refs Submitted for publication

Avail: NTIS HC A08/MF A01

Orbital velocity bunching as an explanation of the response of SAR is proposed, and the restraint of the coherence time of the scattering centers is considered. Key results in random scene image theory as applied to the azimuth wave problem are summarized. Doppler shifts are shown to be a function of wave and sensor geometry. The first order consequence of orbital motion is shown to induce a redistributed scatterer density that may be considered independently from specific SAR performance parameters and the new density can be convolved with the SAR transfer function to derive the expected output image. Focus perturbation of azimuth wave imagery is observed to occur, but only for a specific subset of wave length and wave height circumstances. Scatterer fade is shown to be of central importance in the SAR transfer function. Author (ESA)

N81-33347# Kansas Univ., Lawrence. Remote Sensing Lab.

A REVIEW OF VOLUME SCATTER THEORIES FOR MODELING APPLICATIONS

A. K. Fung *In* ESA Coherent and Incoherent Radar Scattering from Rough Surfaces and Vegetated Areas May 1981 p 83-92 refs

(Grants NSF ENG-79-09374; DAAG29-80-K-0018)

Avail: NTIS HC A08/MF A01

Volume scatter theories commonly applied to develop scatter models for vegetation, snow and sea ice are reviewed. These include the first-order theories based on the Born approximation and the renormalization method; and the multiple scatter theories based on the radiative transfer method and the matrix doubling method. The merits of these scattering theories are compared with those developed by Twersky and Rytov. Applications of the scatter models developed from a first-order theory and a multiple scatter theory are illustrated. Author (ESA)

N81-33348# Marconi Co. Ltd., Chelmsford (England).

SCATTERING THEORY WITH APPLICATION TO SYNTHETIC APERTURE RADAR

S. Rotheram *In* ESA Coherent and Incoherent Radar Scattering from Rough Surfaces and Vegetated Areas May 1981 p 93-98 refs

Avail: NTIS HC A08/MF A01

A Green's function scattering theory is outlined analogous to the T-matrix scattering theory of quantum mechanics and using an integral equation of the Lippman Schwinger type. To apply the scattering theory to microwave imaging the Green's function representations are combined with a system model. A number of SAR imaging mechanisms are identified. These include complex Bragg waves, azimuthal tilting, a motion effect cut-off and a temporal resolution effect. An application to SAR 580 processing is indicated. Author (ESA)

N81-33350# Illinois Univ. at Chicago Circle, Chicago. Communications Lab.

OPTIMAL POLARIZATION CONCEPT IN RADAR IMAGING

Wolfgang-M. Boerner *In* ESA Coherent and Incoherent Radar Scattering from Rough Surfaces and Vegetated Areas May 1981 p 129-142 refs Sponsored also by Humboldt Fellowship National Science and Engineering Research Council of Canada and NATO

(Contracts N00014-80-C-0708; N00014-80-C-0073; Grant DRXR-OPR-P-17227-EL)

Avail: NTIS HC A08/MF A01

Polarization as a factor of electromagnetic scattering is discussed. Due to the vector nature of electromagnetic waves, electromagnetic remote sensing and inverse scattering techniques, if applied rigorously, require incorporation of polarization information into their formulation. By applying this approach to existing and some novel theories, improvements in quality and fidelity of the reconstructed profiles and/or images can be obtained. The development of methods and theories of vector inverse scattering for the electromagnetic polarization-dependent case or in the more complicated seismic case of p and s-wave interaction in elastic media, as for example in Vertical Seismic Profiling, is advocated. Radar scattering matrices and radar measurables are described, as are polarization descriptors. Author (ESA)

N81-33351# Kansas Univ. Center for Research, Inc., Lawrence. Remote Sensing Lab.

SCATTEROMETER CALIBRATION AND DATA CORRECTION

Richard K. Moore *In* ESA Coherent and Incoherent Radar Scattering from Rough Surfaces and Vegetated Areas May 1981 p 149-163
Avail: NTIS HC A08/MF A01

Calibration of radars used for scatterometer purposes and the calibrations necessary to recover the scattering coefficient from the data are discussed. If calibration permits repeatable measurements the system has good relative calibration. Absolute calibration is needed to compare measurements made by different systems or when design data for new systems is needed. Relative calibration may best be done by using a sample of the transmitted signal as a test signal to determine receiver response. Absolute calibration requires either separate calibrations of each part, which are then combined, or the return from a standard target may be used to calibrate the entire system. Surface and volume scatter calculations are illustrated for various situations. Author (ESA)

N81-33528# Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany).
PARTIALLY AUTOMATED OBJECT EXTRACTION FROM AERIAL PHOTOGRAPHS AND LAND MAPS [TEILAUTOMATISCHE OBJELTEXTRAKTION AUS LUFTBILDERN UND LANDKARTEN]
U. Bausch, W. D. Groch, W. Kestner, and M. Sties *In its* Rept. on Cartography and Geodesy, Ser. 1 1980 p 7-22 refs In GERMAN; ENGLISH summary

Avail: NTIS HC A07/MF A01

Object controlled object extraction procedures are presented. Compared with systematic area covering methods such procedures are expected to use less computer time at lower error rates. The principles of methods for extracting linear, surface, and point features are explained, and their accuracy and quality are discussed. The local judgement of gray value profiles for the determination of object outlines is dealt with in detail. One dimensional operators are introduced assigning evaluation numbers to the image points of an image extract. The higher the number; the higher the probability is for a point to lie on a contour. In this way candidates for an object outline are filtered from the selected image range. The various methods were simulated on a computer and tested using different imagery material. Results are shown. Author (ESA)

N81-33541*# Washington Univ., Seattle. Dept. of Geological Sciences.
COMPARISON OF LABORATORY REFLECTANCE SPECTRA AND LANDSAT MULTISPECTRAL IMAGES OF HAWAIIAN LAVA FLOWS
Diane L. Evans, Tom G. Farr, and John B. Adams, Principal Investigators 1981 34 p refs Submitted for publication Sponsored by NASA Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S.D. 57198. ERTS
(E81-10061; NASA-CR-164748) Avail: NTIS HC A03/MF A01 CSCL 08K

Laboratory reflectance spectra of samples with known compositions were compared to LANDSAT multispectral image of Hawaii. The technique used involves determining what the spectral response of a material of interest is at different wavelengths based on laboratory measurements, and searching a stack of spatially registered multispectral images for picture elements with the desired spectral signature. A relatively simple atmospheric correction was employed that combined the effects of gaseous absorption, Rayleigh, and anisotropic aerosol scattering. Laboratory spectal reflectance measurements of surface samples from Hawaii were found to allow mapping of a similar material over many square kilometers in the Hawaii LANDSAT frame, and that correspondence with the known geology and vegetation is excellent. The technique can be generalized to incorporate any bandpasses, and, therefore, has potential for identifying and mapping rock and vegetation types remotely. A.R.H.

N81-33544*# North Carolina State Univ., Raleigh. School of Engineering.
THE USE OF CHARGE TRANSFER DEVICES FOR LANDSAT PATTERN CLASSIFICATION Final Report
[1981] 23 p Sponsored by NASA Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S.D. 57198. ERTS
(E81-10087; NASA-CR-164751) Avail: NTIS HC A02/MF A01 CSCL 05B

Several techniques were developed and tested for increasing the performance of analog or analog/binary systems which perform calculations of Gaussian pattern classification of multispectral data. All the techniques involve scaling of data parameters. The two major sources of inaccuracies in the system are random noise and unpredictable shifts in the zero point. Input scaling, covariance scaling, and x-u scaling are discussed. Application of the these techniques with the prototype system developed resulted in successful classification of land and water with zero errors. A.R.H.

N81-33547*# Vermont Univ., Burlington. School of Natural Resources.
THE DEVELOPMENT OF A REMOTE SENSING APPLICATIONS PROGRAM FOR VERMONT Annual Summary Report, 1 Jun. 1980 - 31 May 1981
Roy A. Whitmore, Jr., Principal Investigator 31 May 1981 59 p Original contains color imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S.D. 57198. ERTS
(Grant NsG-7453)
(E81-10149; NASA-CR-164871) Avail: NTIS HC A04/MF A01 CSCL 08F

Ancillary hardware was obtained to expedite computer processing of remotely sensed data and demonstrations were held to acquaint general and technical interest groups with the facilities and service available. Systems were developed for handling and analyzing data. A Vermont land cover classification scheme and a remote sensing inventory and information system were devised. Specific applications discussed included (1) detecting forest insect defoliation; (2) Brighton land cover/land use mapping or planning; (3) Morristown farmland inventory and agricultural land study; (4) site analysis for a proposed wood-fired electric power plant; and (5) LANDSAT hands-on training course for State of New Hampshire personnel. The acquisition and testing of equipment for small-format aerial photography is also reported. A.R.H.

N81-33551*# Minnesota Univ., St. Paul. Remote Sensing Lab.
DEVELOPMENT OF ALTERNATIVE DATA ANALYSIS TECHNIQUES FOR IMPROVING THE ACCURACY AND SPECIFICITY OF NATURAL RESOURCE INVENTORIES MADE WITH REMOTE SENSING DATA
Thomas M. Lillesand, Principal Investigator *In its* A Study of Minn. Land and Water Resources Using Remote Sensing, Vol. 14 1 Jan. 1981 14 p ERTS

Avail: NTIS HC A05/MF A01 CSCL 05B

The applicability of digital LANDSAT data in updating the Minnesota Lake Land Management Information System and in assessing the trophic status of lakes was investigated. Data from various combinations of training, classification, and geometric correction techniques were compared to a photointerpreted reference data set consisting of ground-verified samples and six randomly selected photographs covering approximately one quarter of the study area. For a reconnaissance inventory, the training via polygons selected from aerial photographs with a canonical analysis minimum distance classifier is the most accurate and efficient analysis technique. The applications test project resulted in disappointing thematic classification results per se, but did contribute to the development of mechanisms for implementing a LANDSAT data processing capability in the State Planning Agency on a permanent basis. A.R.H.

N81-33556*# Science and Education Administration, Weslaco, Tex.
METHODS OF EDITING CLOUD AND ATMOSPHERIC LAYER AFFECTED PIXELS FROM SATELLITE DATA Quarterly Progress Report, 5 Dec. 1980 - 5 Jun. 1981
Paul R. Nixon, Craig L. Wiegand, Arthur J. Richardson, Michael P. Johnson, and Benjamin G. Goodier, Principal Investigators Jun. 1981 12 p ref ERTS
(NASA Order S-75406-B)
(E81-10169; NASA-CR-164769; QR-1; QR-2) Avail: NTIS HC A02/MF A01 CSCL 05B

Removal of such pixels prior to interpretation would avoid erroneous conclusions about Earth surface conditions such as extent and severity of, for example, droughts and freezes and their probable economic impact due to crop losses. The results of a cluster screening procedure applicable to daytime satellite

coverage when reflective (VIS) and emissive (IR) band data are obtained were examined. For a 3 Jul 78 HCMM daytime scene, twenty-eight VIS digital values each accounted for over 1.0% of the pixels in the south Texas test area. The VIS digital value of 42, associated with land features, exceeded all others in frequency of occurrence, accounting for 5.6% of all pixels in the daytime scene. The most common IR digital count value was 80 which was common to both land and water. It accounted for 2.6% of the pixels. T.M.

N81-33557*# National Aeronautics and Space Administration. Earth Resources Labs., Bay St. Louis, Miss.
AN EVALUATION OF MSS P-FORMAT DATA REGISTRATION
Marcellus H. Graham and Raymond C. Luebbe, Principal Investigators Apr. 1981 57 p Sponsored by NASA, USDA, Dept. of Commerce, Dept. of the Interior, and Agency for International Development Prepared in cooperation with Dept. of Agriculture, Washington, D.C. ERTS
(Proj. AgRISTARS)
(E81-10171; NASA-TM-84033; DC-Y1-04069; NSTL/ERL-197) Avail: NTIS HC A04/MF A01 CSCL 02C

Twelve LANDSAT scenes of the P-format were analyzed for registration accuracy based on the hotline oblique mercator (HOM) tick marks contained in the annotation record. Independently chosen ground control points were used to evaluate each scene. The results indicate that 8 out of the 12 showed either good or fairly good registration and that the registration information provided with the MSS data can be used as a starting point from which to make a more precise registration. Author

N81-33562*# Lockheed Engineering and Management Services Co., Inc., Houston, Tex.
AS-BUILT DESIGN SPECIFICATION OF THE AUTOMATIC REGISTRATION SYSTEM FOR THE CARTOGRAPHIC TECHNOLOGY LABORATORY
N. Y. Chu and R. L. Nugent, Principal Investigators Dec. 1980 224 p ERTS
(Contract NAS9-15800)
(E81-10176; NASA-CR-160961; LEMSCO-15904; JSC-17017) Avail: NTIS HC A10/MF A01 CSCL 08B

The function of each processor comprising the automatic registration system is described. This document is intended to be used concurrently with the automatic registration system manual. The system is designed to be used on the PDP 11/45 computer. A.R.H.

N81-33563*# Elogic, Inc., Houston, Tex.
MAXIMUM LIKELIHOOD LABELING
M. E. Rassbach, Principal Investigator Feb. 1981 21 p Sponsored by NASA, USDA, Dept. of Commerce, Dept. of the Interior and Agency for International Development ERTS
(Contract NAS9-15981; Proj. AgRISTARS)
(E81-10177; NASA-CR-160948; SR-X1-04041; NAS-811) Avail: NTIS HC A02/MF A01 CSCL 12A

A method of identifying or labeling the cluster produced by any clustering algorithm has been designed and developed. This associates an externally defined label with each cluster, using a few prelabelled input points. Author

N81-33574*# Telespazio, S.p.A., Rome (Italy).
SOME METHODS OF MULTITEMPORAL ANALYSIS OF LANDSAT IMAGES RESULTING FROM A STUDY ON VENICE LAGOON
Angelo Zandonella, Principal Investigator 1980 5 p refs Presented at the Intern. Conf. on Image Anal. and Process., Pavia, Italy, Oct. 1980 Sponsored by NASA ERTS
(E81-10205; NASA-CR-164770) Avail: NTIS HC A02/MF A01 CSCL 08H

Two methods of analysis were developed. The first method concerns the multitemporal calibration of LANDSAT images. It consists of a projection, onto a common signals feature space, of images recorded in different time periods. The second method relates to multitemporal analysis of gravity center classes in the same feature space. The results obtained are discussed. T.M.

N81-33587# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).
POSSIBLE APPLICATIONS OF COMMUNICATION SATELLITES FOR RESEARCH TASKS IN POLAR REGIONS Final Report
Gerhard Bommas, Erhard Hanka, Jork Haussmann, Walther Klages, Paul Stuerzenhofaecker, and Joachim Thomas Bonn Bundesministerium fuer Forschung und Technologie Dec. 1980 245 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-W-80-029; ISSN-0170-1339) Avail: NTIS HC A11/MF A01; Fachinformationszentrum, Karlsruhe, West Germany DM 41

The possibilities of using communication satellites to establish beyond-the-horizon communications within Antartica, and between Antartica and the Federal Republic of Germany is examined. Communication is shown to be possible using the following satellites: Marisat for the transmission of speech, telex and data, GOES for the transmission of meteorological data, and TIROS-N for the reception of cloud pictures. The coverage of geostationary satellites is limited to a latitude of approximately 80 deg. Links, south of 80 deg are to be established by means of HF. Line of sight communication up to 50 km is simply established with VHF equipment. Author (ESA)

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08

INSTRUMENTATION AND SENSORS

Includes data acquisition and camera systems and remote sensors.

A81-41476 **Some results on the investigation of earth resources by aerial and polygon methods (Nekotorye rezul'taty issledovaniia prirodnykh resursov s pomoshch'iu samoletnykh i poligonnykh sredstv).** Edited by N. K. Vinnichenko and A. P. Tishchenko. Leningrad, Gidrometeoizdat (Nauchno-Issledovatel'skii Tsentr Izucheniia Prirodnykh Resursov, Trudy, No. 10), 1980. 119 p. In Russian.

Papers are presented on integrated aerial-satellite remote sensing systems, the resolution of TV scanning systems, the transfer of spectral contrasts in multispectral photography, and pseudocolor representation of multispectral aerial images. Consideration is also given to the use of spectral and physical-geographic characteristics of natural objects on the earth's surface for the interpretation of multispectral satellite photographs, the determination of the types and state of crops from multispectral aerial images, and the automated classification of agricultural objects from their multispectral aerial images. B.J.

A81-41477 # **Aerial data acquisition systems using test-ground polygons (Aviatsionnye sredstva sbora informatsii na kontrol'no-izmeritel'nykh poligonakh).** N. K. Vinnichenko, A. D. Dobrozrakov, and V. P. Iakovlev. In: Some results on the investigation of earth resources by aerial and polygon methods. Leningrad, Gidrometeoizdat, 1980, p. 3-12. In Russian.

Consideration is given to a remote sensing system based on the integration of satellite-borne and airborne sensors. It is shown that, when integrated into a satellite remote sensing system, aerial data acquisition systems (i.e., aircraft and helicopter platforms) can perform the independent function of data acquisition on test-ground polygons, and can solve various auxiliary problems in the interests of promoting the operation of the satellite system. B.J.

A81-41483 # **Pseudocolor representation of multispectral aerial images by means of a three-channel projector (Psevdotsvetnoe predstavlenie mnogozonal'nykh aeroizobrazhenii s pomoshch'iu trekhkanal'nogo proektora).** A. N. Belinskii. In: Some results on the investigation of earth resources by aerial and polygon methods. Leningrad, Gidrometeoizdat, 1980, p. 42-44. In Russian.

Attention is given to the use of a three-channel projector for the synthesis of color images of one region of the earth's surface obtained at three different wavelengths. Results on the visual interpretation of several pseudocolor images of agricultural lands are discussed. B.J.

A81-41915 # **The effect of angular distribution models on the estimation of the earth's albedo.** H. Jacobowitz (NOAA, Earth Sciences Laboratory, Marlow Heights, MD). *American Meteorological Society and Canadian Meteorological Oceanographic Society, Conference on Atmospheric Radiation, Toronto, Canada, June 16-18, 1981, Paper.* 3 p.

The considered investigation is concerned with the differences between the models that have been utilized in processing the narrow-angle data and the consequent effects of the differences on the estimation of the earth's albedo. The processing of the Nimbus-7 Earth Radiation Budget (ERB) narrow-angle data into hemispheric albedoes first made use of angular distribution models which consisted of angular distributions for three surface types, including cloud-land, ocean, and for latitudes greater than 65 deg snow and ice. A comparison of the zonal profiles of albedo utilizing these models with that derived from the wide-angle sensors showed rather large differences. To assess the cause of these differences, Stowe et al. (1980) conducted a comparison between these models and a preliminary one derived from a composite 9 day set of ERB radiance data. Data for a comparison between wide and narrow channel estimates of zonal means of the earth's albedo are presented in a table. G.R.

A81-41916 # **A new numerical treatment of the source function in the radiative transfer equation.** H. E. Fleming (NOAA, National Earth Satellite Service, Washington, DC). *American Meteorological Society and Canadian Meteorological Oceanographic Society, Conference on Atmospheric Radiation, Toronto, Canada, June 16-18, 1981, Paper.* 4 p.

A81-41919 * # **A radiometric model of an earth radiation budget radiometer optical system with diffuse-specular surfaces.** M. R. Luther (NASA, Langley Research Center, Hampton, VA). *American Meteorological Society and Canadian Meteorological Oceanographic Society, Conference on Atmospheric Radiation, Toronto, Canada, June 16-18, 1981, Paper.* 9 p. 11 refs.

The Earth Radiation Budget Experiment (ERBE) is to fly on NASA's Earth Radiation Budget Satellite (ERBS) and on NOAA F and NOAA G. Large spatial scale earth energy budget data will be derived primarily from measurements made by the ERBE nonscanning instrument (ERBE-NS). A description is given of a mathematical model capable of simulating the radiometric response of any of the ERBE-NS earth viewing channels. The model uses a Monte Carlo method to accurately account for directional distributions of emission and reflection from optical surfaces which are neither strictly diffuse nor strictly specular. The model computes radiation exchange factors among optical system components, and determines the distribution in the optical system of energy from an outside source. Attention is also given to an approach for implementing the model and results obtained from the implementation. G.R.

A81-41920 * # **Performance evaluation of a spaceborne scatterometer.** W. L. Grantham, E. M. Bracalente, W. L. Jones, Jr., L. C. Schroeder (NASA, Langley Research Center, Hampton, VA), C. L. Britt, Jr. (Research Triangle Institute, Hampton, VA), and F. J. Wentz (Remote Sensing Systems, Sausalito, CA). *Institute of Electrical and Electronics Engineers, Oceans '81 Conference, Boston, MA, Sept. 16-18, 1981, Paper.* 7 p. 7 refs.

Study results are presented showing performance capability of a spaceborne scatterometer to operationally measure ocean surface wind speed and direction. In addition, a research mode is described which will allow development of improved radar signatures for ocean, sea ice, and land targets. The study results show that a scatterometer can meet the operational requirements of + or - 2 m/s wind speed accuracy (or + or - 10%, whichever is greater) and + or - 20 deg wind direction accuracy over most of the expected ocean surface conditions. The six beam scatterometer design evaluated is shown to be skillful (greater than 90% correct) in specifying the correct wind vector solution (with a 180 deg ambiguity) from the multiple solutions derived; further improvement must rely on meteorological and pattern recognition techniques now under study. (Author)

A81-41995 **What has been learned from the scanning multi-channel microwave radiometers /SMMRs/.** J. Alishouse (NOAA, National Earth Satellite Service, Washington, DC). *Marine Technology Society Journal,* vol. 14, no. 6, 1980, p. 12, 13.

Two SMMRs have been flown, one on Seasat and the other on Nimbus-7. The two radiometers are essentially identical. Both have five frequencies, 6.63, 10.69, 18, 21, and 37 GHz and dual polarizations. Two algorithms have been used in the Seasat SMMR data processing to derive geophysical parameters. One is a nonlinear, least squares, iterative estimation technique, a type of Kalman filtering. The other is a regression technique with coefficients derived from simulation. The regression is essentially linear. Attention is given to sea surface temperature, sea surface wind speed, total precipitable water (water vapor), and corrections for the altimeter and the scatterometer. G.R.

A81-42284 # **The signal-to-noise ratio of a space photographic system (Otnoshenie signal-shum kosmicheskoi fotograficheskoi sistemy).** L. M. Matiiasevich (Gosudarstvennyi Nauchno-Issledovatel'skii i Proizvodstvennyi Tsentr Priroda, USSR). *Issledovanie Zemli iz Kosmosa,* May-June 1981, p. 66-76. 11 refs. In Russian.

The concept of the signal-to-noise ratio is discussed in relation to a spaceborne photographic system used for the remote sensing of earth resources. The problems of a numerical determination of this value are considered, and it is shown that the signal is best

characterized by three parameters: the density component (signal amplitude), the spatial dimension, and the frequency. A means for the practical application of this ratio is discussed. J.F.

A81-42285 # Concerning the possibility of improving the spectroradiometric accuracy of remote sensing of the earth by means of multispectral band scanners (O vozmozhnom povyshenii spektroradiometricheskoi tochnosti pri distantsionnykh issledovaniiakh zemli s pomoshch'iu mnogozonal'nykh s'emochnykh sistem). A. A. Bogdanov, V. N. Nalimov, A. G. Sychev, V. I. Tarnopol'skii, and G. N. Tolstykh (Akademiia Nauk SSSR, Institut Kosmicheskikh Issledovanii; Vsesoiuznyi Nauchno-Issledovatel'skii Institut Optiko-Fizicheskikh Izmerenii, Moscow, USSR). *Issledovanie Zemli iz Kosmosa,* May-June 1981, p. 77-84. 7 refs. In Russian.

Possibilities are discussed for decreasing the uncertainty of an object's emission spectrum by improving the accuracy of the calibration method and by applying a special processing method to the obtained data. It is shown that in measuring object brightness in several spectral bands, the true spectral dependence of brightness values can be determined by the method of successive approximation. The application of this technique to the remote sensing of the earth's surface by spaceborne multispectral band scanners is considered. J.F.

A81-42286 # Concerning the reliability estimation of information obtained from several sources in earth survey tasks (Ob otsenke dostovernosti informatsii ot neskol'kikh istochnikov v zadache zemleobzora). O. P. Nesterenko, Iu. A. Smol'ianinov, and S. D. Nadberezhnyi. *Issledovanie Zemli iz Kosmosa,* May-June 1981, p. 85-88. In Russian.

The problem of formulating a reliability estimation of information obtained simultaneously from satellite-borne remote sensing systems is presented. A complete a posteriori probability of the true message is averaged from several observed results and set as a function of a priori distribution. J.F.

A81-42671 * Calibration validation for the GEOS 3 altimeter. C. F. Martin (EG & G Washington Analytical Services Center, Inc., Riverdale, MD) and R. Kolenkiewicz (NASA, Goddard Space Flight Center, Greenbelt, MD). *Journal of Geophysical Research,* vol. 86, July 10, 1981, p. 6369-6381. 18 refs.

An absolute calibration of the altitude data is needed for some applications of the large quantity of altimeter data taken by the GEOS 3 intensive mode altimeter. The considered calibration technique is based on the use of a gravimetric geoid model and satellite passes which are nearly overhead at island laser tracking sites. Near overhead passes of GEOS 3 were achieved at Bermuda. Two of these passes were tracked by the Bermuda laser. The reported investigation has the objective to obtain a best estimate of the GEOS 3 altimeter calibration bias, using the two available passes and reconciling differences between them. Assuming that orbits with accurate altitudes over Bermuda are obtained, discrepancies between the two passes could be due to incorrect time tagging of the altimeter data. To assist in the resolution of the timing question, additional GEOS 3 passes through the calibration area were selected. On the basis of the obtained results, it is recommended to add 10.24 ms to GEOS 3 altimeter time tags before using the data. G.R.

A81-43071 * Passive microwave techniques for geophysical sensing of the earth from satellites. D. H. Staelin (MIT, Cambridge, MA). *IEEE Transactions on Antennas and Propagation,* vol. AP-29, July 1981, p. 683-687. 61 refs. Grant No. NAG5-10.

Passive microwave techniques for geophysical probing from aircraft and space have employed frequencies 1-300 GHz and have yielded information about atmospheric temperature and composition profiles and about surface parameters such as sea state, ice and snow type and extent, soil moisture, etc. The initially scientific program is now evolving into various operational spacecraft observatory systems; this mini-review summarizes recent accomplishments and future opportunities. (Author)

A81-43190 * Advanced technology for satellite data collection systems. C. E. Cote and J. E. Painter (NASA, Goddard Space Flight Center, Greenbelt, MD). In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979. Minneapolis, MN, American Water Resources Association, 1981, p. 65-67. 6 refs.

Technological developments in satellite data collection are aimed at relieving constraints of existing systems to permit expanded capability at lower costs in future operations. Constraints imposed by the limited electromagnetic spectrum available in the UHF band and the cost of user equipment are principal targets for improvement through technology. This paper describes ongoing developmental activities in system and component areas which will become available for the next generation of operations. (Author)

A81-43223 * Potential application of satellite radar to monitor soil moisture. F. T. Ulaby, G. A. Bradley, and M. C. Dobson (University of Kansas Center for Reserach, Inc., Lawrence, KS). In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979. Minneapolis, MN, American Water Resources Association, 1981, p. 363-370. 29 refs. Contract No. NAS9-14052.

The microwave backscattering characteristics of soils as a function of moisture content are reviewed as a basis for the evaluation of the applicability of satellite radar to soil moisture determinations. Results of experiments showing the dependence of the complex dielectric constant, power reflection coefficient and backscattering coefficient of soil on its volumetric moisture content are presented. Results of a research program using the truck-mounted University of Kansas microwave active spectrometer to determine if, by the proper choice of sensor frequency, polarization and incidence, the sensor dynamic range in response to moisture variations may be greater than its response to other variations are considered in detail, and the optimum conditions of frequency (between 4 and 5 GHz), angular incidence (between 7 and 20 deg from nadir) and polarization (HH) obtained are indicated. An empirical model for the backscattering coefficient as a function of gravimetric moisture content derived on the basis of the experimental data is presented, and it is noted that available airborne and spaceborne data confirm the results of the ground-based sensors. A.L.W.

A81-43225 * Requirements of space-borne microwave radiometers for detecting soil moisture contents. H.-H. K. Burke (Environmental Research and Technology, Inc., Concord, MA) and W. J. Burke (Boston College, Chestnut Hill, MA). In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979. Minneapolis, MN, American Water Resources Association, 1981, p. 377-383. 13 refs. Contracts No. NAS5-25529; No. NAS5-25527.

A multilayer radiative transfer model for predicting the relationship between soil moisture content and microwave emission is summarized. Attention is also given to the performance of various microwave sensors for soil moisture retrieval; here, the requirements of a satellite sensor system for monitoring large-scale soil moisture conditions are discussed. These requirements are presented in terms of (1) the wavelength, (2) atmospheric contamination, (3) polarization, (4) frequency of observation, and (5) spatial resolution. Each parameter is discussed in terms of microwave response. Previous aircraft data with extensive ground truth information are used to support the theories proposed. Trade-offs between the parameters and an optimum sensor system for space monitoring soil moisture information are discussed. C.R.

A81-43260 * Land subsidence measured by satellite radar altimetry. W. B. Krabill (NASA, Wallops Flight Center, Wallops Island, VA) and R. L. Brooks (GeoScience Research Corp., Salisbury, MD). In: Satellite hydrology; Proceedings of the Fifth Annual William T. Pecora Memorial Symposium on Remote Sensing, Sioux Falls, SD, June 10-15, 1979. Minneapolis, MN, American Water Resources Association, 1981, p. 683-688. Contract No. NAS6-2639.

Radar altimeter measurements from the GEOS-3 and SEASAT satellites are being evaluated to assess their potential contribution to terrain mapping. The primary evaluation area is the San Joaquin Valley of southern California; 40,000/sq km of the Valley have been mapped at a contour interval of 10 m from the satellite altimeter measurements. The accuracy of the altimeter derived terrain eleva-

tions is being assessed by comparison with 1:24,000 and digitized 1:250,000 maps and by intercomparisons at the crossover altimeter intersections. Comparisons of the altimeter derived elevations with historical maps archived at the U.S. Geological Survey confirms the USGS 1926-1972 subsidence contours for this area. Preliminary results from a similar analysis in the Houston-Galveston area of subsidence also demonstrates a capability of measuring land subsidence by satellite altimetry. (Author)

A81-43530 **Hardware aspects of digital mapping.** G. Petrie (Glasgow, University, Glasgow, Scotland). *(International Society for Photogrammetry, Congress, 14th, Hamburg, West Germany, July 13-25, 1980.) Photogrammetric Engineering and Remote Sensing,* vol. 47, Mar. 1981, p. 307-320. 28 refs.

The respective merits of digitizing photogrammetrically produced graphic plots and direct photogrammetric digitizing are described. The characteristics of various types of photogrammetric digitizing units are discussed, including representative examples of large multistation systems. Particular consideration is given to the trend toward the implementation of standard hardware interfaces and the incorporation of graphic displays into photogrammetric digitizing systems. A summary is then given of experiences with interactive graphic systems interfaced directly to stereoplotting machines reported by a number of North American mapping agencies. B.J.

A81-43547 * **Aircraft active microwave measurements for estimating soil moisture.** T. J. Jackson (U.S. Science and Education Administration, Hydrology Laboratory, Beltsville, MD), A. Chang, and T. J. Schmugge (NASA, Goddard Space Flight Center, Greenbelt, MD). *Photogrammetric Engineering and Remote Sensing,* vol. 47, June 1981, p. 801-805. 7 refs.

Both active and passive microwave sensors are sensitive to variations in near-surface soil moisture. The principal advantage of active microwave systems for soil moisture applications is that high spatial resolution can be retained even at satellite attitudes. The considered investigation is concerned with the use of active microwave scatterometers for estimating near-surface soil moisture. Microwave scatterometer data were obtained during a series of three aircraft flights over a group of Oklahoma research watersheds during May 1978. Data were obtained for the C, L, and P bands at angles of incidence between 5 and 50 degrees. The best results were obtained using C band data at incidence angles of 10 and 15 degrees and soil moisture depth of 0 to 15 cm. These results were in excellent agreement with the conclusions of the truck-mounted scatterometer measurement program reported by Ulaby et al. (1978, 1979). G.R.

A81-43735 **Relating ground level reflected radiance measurements in the Landsat MSS bandpasses to satellite altitudes.** M. J. Duggin (New York, State University, Syracuse, NY) and P. J. Ellis (Department of Scientific and Industrial Research, Physics and Engineering Laboratory, Lower Hutt, New Zealand). In: Rainbow 80; Fall Technical Meeting, Niagara Falls, NY, October 7-10, 1980, ASP Technical Papers. Falls Church, VA, American Society of Photogrammetry, 1981, p. RS-1-G-1 to RS-1-G-10. 16 refs. Research supported by the U.S. Department of Agriculture and New York State Department of Environmental Conservation.

Ground truth radiometers (GTRS) are used to test the feasibility of resource discrimination, mapping and quantification using Landsat digital multispectral scanner (MSS) data. The effect on differences of target spectral response for healthy and diseased vegetation is studied. The differences between recorded output from GTRS and the Landsat MSSs when viewing the same target under identical conditions are calculated. The average obtained for the mean normalized signal (NS) values in each bandpass of each MSS was used as a standard to which NS values calculated for the GTRs were compared. Although differences of up to 13% occurred in MSS 7, and two large differences (up to 20%) were found in MSS 5, general agreement (differences of 5% or less) was usual. This indicates that the GTRs, which are simple and inexpensive, can provide satisfactory ground reflectance data, which can be related accurately to Landsat data. J.F.

A81-45836 * # **Earth applications orbit analysis for a shuttle-mounted Multispectral Mapper.** J. M. Driver and C. C. H. Tang (California Institute of Technology, Jet Propulsion Laboratory, Mission Design Section, Pasadena, CA). *American Astronautical Society and American Institute of Aeronautics and Astronautics, Astrodynamics Specialist Conference, Lake Tahoe, NV, Aug. 3-5, 1981, AAS Paper 81-182.* 24 p. 8 refs. Contract No. NAS7-100.

The earth remote sensing problem of orbit design to acquire images with inherent geometric and geodetic accuracy is addressed. The basis for precise orbit modeling is discussed. Various orbit propagation tools are compared. Orbit characteristics for a nominal case at shuttle altitude are displayed. Modeling Parameter sensitivities are evaluated to determine limits on orbit propagation accuracy versus time. It is found that attainable propagation accuracies are sufficient for image quality assessment over the short term at the 15m pixel size desired for a Multispectral Mapper. (Author)

A81-45872 * **Progress in passive microwave remote sensing - Nonlinear retrieval techniques.** D. H. Staelin (MIT, Cambridge, MA). In: Remote sensing of atmospheres and oceans; Proceedings of the Interactive Workshop on Interpretation of Remotely Sensed Data, Williamsburg, VA, May 23-25, 1979. New York, Academic Press, Inc., 1980, p. 259-274; Discussion, p. 275, 276. 10 refs. Contract No. NAS5-22929.

A variety of nonlinear retrieval methods have been applied to passive microwave remote sensing problems. These problems can be characterized in part by the degree to which their underlying physics and statistics can be understood and characterized in a simple way. Four examples of varying complexity are considered here; the simplest problem requires only analytic expressions for retrievals, whereas the most complex problem has been handled only with pattern classification techniques. The four examples are: (1) Doppler measurements of winds at 70 to 100 km, (2) retrieval of atmospheric water vapor profiles using the opaque 183-GHz water vapor resonance, (3) retrieval of snow accumulation rate by means of combined theoretical and empirical procedures, and (4) classification of diverse polar terrain by means of pattern recognition techniques. (Author)

A81-45873 * **Inversion of multiwavelength radiometer measurements by three-dimensional filtering.** P. W. Rosenkranz and W. T. Baumann (MIT, Cambridge, MA). In: Remote sensing of atmospheres and oceans; Proceedings of the Interactive Workshop on Interpretation of Remotely Sensed Data, Williamsburg, VA, May 23-25, 1979. New York, Academic Press, Inc., 1980, p. 277-310; Discussion, p. 310, 311. 18 refs. Contract No. NAS5-22929.

Remote sensing data from satellites typically have three dimensions: scan position, spacecraft position, and wavelength. Inversion of the radiometric data to infer geophysical parameters is a filtering problem in which the dimension of wavelength (or channel number) is transformed into a dimension of geophysical parameters, and the most general solution is a three-dimensional filter. Linear filters have the advantages of computational speed and easily described transfer functions; but often the measurements are nonlinear functions of the parameters to be inferred. To the extent that the nonlinear inversion problem is overdetermined, it can be modeled by a critically determined linear problem. As an example, inversion of Scanning Multichannel Microwave Radiometer (SMMR) data by means of a three-dimensional Wiener Filter is described. Atmospheric water vapor content, rain liquid water content, surface wind speed and surface temperature are the parameters inferred from the measurements. Nonprecipitating liquid water and water vapor scale height are also modeled but not retrieved. The a priori statistics on which the filter is trained have the effect of governing the selection of a trade-off point of noise as a function of resolution (in all three retrieval dimensions). (Author)

A81-45879 * **Atmospheric correction of Nimbus-7 Coastal Zone Color Scanner imagery.** H. R. Gordon (Miami, University, Coral Gables, FL), J. L. Mueller (NASA, Goddard Space Flight Center, Laboratory for Atmospheric Sciences, Greenbelt, MD), and R. C. Wrigley (NASA, Ames Research Center, Moffett Field, CA). In: Remote sensing of atmospheres and oceans; Proceedings of the Interactive Workshop on Interpretation of Remotely Sensed Data, Williamsburg, VA, May 23-25, 1979. New York, Academic Press, Inc., 1980, p. 457-481; Discussion, p. 482, 483. 11 refs. Contract No. NAS5-22963.

The Coastal Zone Color Scanner (CZCS) on Nimbus-7 is a scanning radiometer designed to view the ocean in six spectral bands

(centered at 443, 520, 550, 670, 750, and 11,500 nm) for the purpose of estimating sea surface chlorophyll and temperature distributions. In the visible bands, the atmosphere obscures the imagery to the extent that at 443 nm, at most, only 20 percent of the observed radiance originates from beneath the sea surface. Retrieving this subsurface radiance from the imagery is complicated by the highly variable nature of the aerosol's contribution. In this paper, an algorithm for the removal of these atmospheric effects from CZCS imagery is described, a preliminary application of the algorithm to an image with very strong horizontal variations in the aerosol optical thickness is presented, and retrieval of the spatial distribution of the aerosol optical thickness is discussed. (Author)

A81-46028 * Parallel processing implementations of a contextual classifier for multispectral remote sensing data. H. J. Siegel, P. H. Swain, and B. W. Smith (Purdue University, West Lafayette, IN). In: Machine processing of remotely sensed data and soil information systems and remote sensing and soil survey; Proceedings of the Sixth Annual Symposium, West Lafayette, IN, June 3-6, 1980. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 19-29. 19 refs. Contract No. NAS9-15466.

The applicability of parallel processing schemes to the implementation of a contextual classification algorithm which exploits the spatial and spectral context of a multispectral remote sensing pixel to achieve classification is examined. Two algorithms for classifying each multivariate pixel taking into account the probable classifications of neighboring pixels are presented which make use of a size three horizontally linear neighborhood, and the serial computational complexity of the more efficient algorithm is shown to grow in proportion to the number of pixels and the cube of the number of possible categories. The implementation of the more efficient algorithm on a CDC Flexible Processor system and on a multimicroprocessor system such as the proposed PASM is then discussed. It is noted that the use of N processors to perform the calculations N times faster than a single processor overcomes the principal disadvantage of contexual classifiers, i.e., their computational complexity. A.L.W.

A81-46029 Automatic processing of computer compatible tapes with data from multispectral scanners installed in Landsat satellites. N. Scquizzato (Comisión Nacional de Investigaciones Espaciales, Buenos Aires, Argentina). In: Machine processing of remotely sensed data and soil information systems and remote sensing and soil survey; Proceedings of the Sixth Annual Symposium, West Lafayette, IN, June 3-6, 1980. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 30-39.

The design and operation of the STAI (Spanish acronym for ground data analysis system) for the digital processing of multispectral remote sensing data on computer compatible tapes are discussed. The interactive system consists of a central processing unit, main memory system, nine-track magnetic tape unit, magnetic tape controller, teletype, high-speed paper tape reader/punch, interface extension unit, sensor data input processor, black and white film recorder, tape playback unit, moving window display, color monitor, color film printing subsystem, operator panel, and tape operating system. Features to be added in the future include a table digitizer, color film digitizer and processor, and electrostatic printer plotter. Landsat CCTs can be displayed and processed using the moving window display as a first step in classification. Images are displayed at a vertical scale of 1:100,000 and horizontal scales of either 1:100,000 or 1:50,000. A.L.W.

A81-46030 The Lulea Image Processing System /LIPS/ - A versatile approach to earth resources data processing. H. Hauska (Lulea, Hogskola, Lulea, Sweden). In: Machine processing of remotely sensed data and soil information systems and remote sensing and soil survey; Proceedings of the Sixth Annual Symposium, West Lafayette, IN, June 3-6, 1980. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 40-46. 14 refs. Styrelsen for Teknisk Utveckling Contracts No. 76-6669; No. 77-6345.

The minicomputer-based Lulea Image Processing System (LIPS), which was developed for earth resources data processing applications, is presented. The system was designed according to the available hardware (Nord 10/S CPU), and the criteria of ease of use, flexibility, portability, efficiency, ease of maintenance and batch capability. Image data files contain information on image identity and processing history as well as the image data itself quantized in grey scale values. The software is structured in two levels corresponding to a control program and processing level programs in the form of a pseudo-overlay. The modular processing modules include provisions for preprocessing, hard copy image output, orthogonal transformation, geometric correction, classification and the estimation of statistical parameters. Future improvements to the system include a color digital display system to provide true interactivity, and an image reading device. A.L.W.

A81-46038 * Radar image preprocessing. V. S. Frost, J. A. Stiles, J. C. Holtzman (University of Kansas Research Center, Inc., Lawrence, KS), and D. N. Held (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA). In: Machine processing of remotely sensed data and soil information systems and remote sensing and soil survey; Proceedings of the Sixth Annual Symposium, West Lafayette, IN, June 3-6, 1980. New York, Institute of Electrical and Electronics Engineers, Inc., 1980, p. 140-146. 14 refs. Research supported by the California Institute of Technology; Contract No. NAS7-100; Grant No. DAAG29-77-G-0075.

Standard image processing techniques are not applicable to radar images because of the coherent nature of the sensor. Therefore there is a need to develop preprocessing techniques for radar images which will then allow these standard methods to be applied. A random field model for radar image data is developed. This model describes the image data as the result of a multiplicative-convolved process. Standard techniques, those based on additive noise and homomorphic processing are not directly applicable to this class of sensor data. Therefore, a minimum mean square error (MMSE) filter was designed to treat this class of sensor data. The resulting filter was implemented in an adaptive format to account for changes in local statistics and edges. A radar image processing technique which provides the MMSE estimate inside homogeneous areas and tends to preserve edge structure was the result of this study. Digitally correlated Seasat-A synthetic aperture radar (SAR) imagery was used to test the technique. (Author)

A81-46196 Does the use of two radiometers correct for irradiance changes during measurements. E. J. Milton (Durham, University, Durham, England). *Photogrammetric Engineering and Remote Sensing*, vol. 47, Aug. 1981, p. 1223-1225. 9 refs.

The method of inter-calibrating two field radiometers proposed by Duggin (1980) is critically assessed. It is claimed that by this method it is possible to correct for the effects of variations in total solar irradiation upon hemispherical directional reflectance during a series of measurements. However, this is questioned because, in theory, the non-Lambertian nature of most natural surfaces prevents such a correction. Furthermore, it is shown that in practice, intra-canopy shadow effects are likely to confound the proposed method. Uniform irradiation conditions are seen as the only suitable environment for the field measurement of reflectance factors. (Author)

A81-46241 * # Magnetic space-based field measurements. R. A. Langel (NASA, Goddard Space Flight Center, Geophysics Branch, Greenbelt, MD). *American Astronautical Society, Goddard Memorial Symposium on International Space Technical Applications, 19th, Arlington, VA, Mar. 26, 27, 1981, Paper 81-077.* 18 p. 18 refs.

Satellite measurements of the geomagnetic field began with the launch of Sputnik 3 in May 1958 and have continued sporadically in the intervening years. A list of spacecraft that have made significant contributions to an understanding of the near-earth geomagnetic field is presented. A new era in near-earth magnetic field measurements began with NASA's launch of Magsat in October 1979. Attention is given to geomagnetic field modeling, crustal magnetic anomaly studies, and investigations of the inner earth. It is concluded that satellite-based magnetic field measurements make global surveys practical for both field modeling and for the mapping of large-scale crustal anomalies. They are the only practical method of accurately modeling the global secular variation. Magsat is providing a significant contribution, both because of the timeliness of the survey and because its vector measurement capability represents an advance in the technology of such measurements. G.R.

A81-46401 Identification of subresolution high temperature sources using a thermal IR sensor. M. Matson (NOAA, National Earth Satellite Service, Washington, DC) and J. Dozier (California, University, Santa Barbara, CA). *Photogrammetric Engineering and Remote Sensing,* vol. 47, Sept. 1981, p. 1311-1318. 14 refs.

Simultaneous use of the 3.8-micron and 11-micron thermal infrared channels on board the 3rd-generation NOAA-6 environmental satellite provides the capability to detect subresolution scale high-temperature sources, and to estimate both the temperature and size of such sources. Examples presented include gas flares from oil fields in the Middle East and steel mills in the midwestern United States. (Author)

A81-46461 First Shuttle payload loading to begin. C. Covault. *Aviation Week and Space Technology,* vol. 114, June 29, 1981, p. 54, 55, 57, 59.

The first Office of Space and Terrestrial Applications (OSTA 1) Space Shuttle payload, a multi-instrument array aimed at the development of oil and mineral exploration from space, will be carried into orbit by the second Columbia Orbiter mission. The Spacelab pallet mounting of the package incorporates: (1) the Shuttle imaging radar (SIR-A), which will study geological formations; (2) the Shuttle multispectral infrared radiometer; (3) a feature identification and location experiment; (4) an ocean color experiment; and (5) an air pollution measurement-from-satellite experiment. In one of the two OSTA 1 experiments to be conducted from the Shuttle cabin, photographic studies will be made of lightning propagation across thunderstorms. O.C.

A81-46679 The European SAR-Project Convair 580 (Die Europäische SAR-Kampagne CV 580). A. Sieber (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für Hochfrequenztechnik, Oberpfaffenhofen, West Germany) and P. Hartl (Berlin, Technische Universität, Berlin, West Germany). *Bildmessung und Luftbildwesen,* vol. 49, Sept. 1, 1981, p. 165-170. In German.

The considered investigation is concerned with the possibilities and problems regarding an employment of Synthetic Aperture Radar (SAR) sensors in space missions with earth observation applications. The significance of the SAR Project for the European Microwave Remote Sensing program is discussed, taking into account the Microwave Remote Sensing Experiment, the establishment of national and international user organizations, and the support of research work related to radar systems. The organization of the entire project is considered along with the observational parameters for the SAR system. Test areas in Germany have been selected for a calibration of the SAR systems. Investigations related to snow and ice are to be conducted in Switzerland and Austria, while questions of glaciology and hydrology are to be studied in Greenland. G.R.

A81-46924 # Radar methods for studying the earth (Radiolokatsionnye metody issledovaniia zemli). Iu. A. Mel'nik, S. G. Zubkovich, V. D. Stepanenko, Iu. P. Sokolov, V. A. Gubin, V. E. Dulevich, S. V. Pereslegin, A. A. Veretiagin, V. M. Glushkov, and Iu. A. Iurkov. Moscow, Izdatel'stvo Sovetskoe Radio, 1980. 288 p. 118 refs. In Russian.

The principles of earth radar studies are presented. Models of reflection and characteristics of radar signals from land and water surfaces as well as atmospheric formations are discussed in detail. The methods for constructing and substantiating the parameters of active radar and radiometer systems used in observations of the earth's surface and meteorological objects from flight vehicles and satellites are presented. Methods for studying the active and passive radar methods used in cartography, geology, hydrology, oceanography, studies of vegetation cover, ice reconnaissance, and other geophysical fields are also discussed. J.F.

A81-47338 Data collection and location by satellite - The Argos system. J. L. Bessis (Centre Nationale d'Etudes Spatiales, Paris, France). *International Astronautical Federation, International Astronautical Congress, 32nd, Rome, Italy, Sept. 6-12, 1981, Paper 81-80.* 18 p. 11 refs.

A description is given of the data collection and platform location functions of the Argos system, carried onboard NOAA meteorological satellites, whose environmental concerns include meteorology, oceanography, offshore phenomena, hydrology, biology, vulcanology, and seismology. The system comprises such user platforms as buoys, balloons, fixed or offshore stations, animals, etc., on-board equipment, a data processing center, and a data distribution system for Argos users. It is shown that platform results are available within hours after their acquisition by satellite, and are readily accessible by means of telephone or telex network from anywhere in the world. Flowcharts are presented for the management responsibilities of the various managing agencies, the user platform, the on-board data collection system, the data processing center, and software. O.C.

A81-47342 Passive microwave systems. E. Schanda (Bern, Universität, Berne, Switzerland). *International Astronautical Federation, International Astronautical Congress, 32nd, Rome, Italy, Sept. 6-12, 1981, Paper 81-88.* 14 p. 20 refs.

Passive microwave sensors are presently applied on spaceborne platforms for investigations of large scale phenomena in geoscience and hydrology as well for the regular observation of meteorological features. Results of ground-based and airborne experiments over well-controlled test areas together with the present experience in synoptic earth observations from space can now be used for defining sensor systems for operational application in various fields of geoscience. Two examples are discussed: First the elements of a microwave payload for the global observation of the extent, the development and the hydrological state of the snow cover. Second, a payload for the measurement of the three-dimensional distribution of several minor constituents and of the temperature of the middle atmosphere by technique of limb sounding from Spacelab. (Author)

A81-47345 Program and instrumentation of the satellite experiment Bulgaria-1300 II. D. Mishev, K. Serafimov (B'lgarska Akademiia na Naukite, Tsentralna Laboratoriia po Kosmicheski Izsledvaniia, Sofia, Bulgaria), Iu. Trifonov, and I. Vetlov (Academy of Sciences, Intercosmos Council, Moscow, USSR). *International Astronautical Federation, International Astronautical Congress, 32nd. Rome, Italy, Sept. 6-12. 1981, Paper 81-91.* 6 p.

The Bulgaria-1300 II complex will study the relationship between various natural formations with reflected and emitted electromagnetic radiation in the visual, near infrared, and VHF range of the spectrum. The studies, which will be spaceborne, airborne, and ground-based, will give descriptions of natural formations and their state based on objective physical characteristics. The Bulgaria-1300 II spacecraft, which will be launched in solar synchronous orbit, incorporates a four-channel scanner of low selective capability (MSU-M), a two-channel scanner of average selective capability (MSU-S), four VHF radiometers in the centimeter range, and a 32-channel spectrometer system in the visible and near-infrared range. The complex will operate in various modes, including direct data transmission, onboard data recording and sequential transmission to earth. Basic instrumental parameters of the spectrometer SMP-32 and the radiometers RM1 - RM4 are given, and the MSU-M and MSU-S scanners are discussed in greater detail. J.F.

A81-47360 Meteorological applications of the ARGOS system. J. L. Bessis (Centre National d'Etudes Spatiales, Paris, France). *International Astronautical Federation, International Astronautical Congress, 32nd, Rome, Italy, Sept. 6-12, 1981, Paper 81-121.* 15 p. 10 refs.

Attention is given to the way in which the ARGOS system can improve the meteorological network by using drifting buoys in connection with oceanographic data and balloons. Also discussed is the way in which moored meteorological buoys can be used to increase the forecasting period for weather analysis. C.R.

A81-47407 New complex for ionosphere-magnetosphere study 'Intercosmos-Bulgaria-1300'. K. Serafimov, I. Kutiev, S. Chapk'nov, M. Gogoshev, A. Bochev, Ts. Dachev, I. Ivanov (B'lgarska Akademiia na Naukite, Tsentralna Laboratoriia po Kosmicheski Izsledvaniia, Sofia, Bulgaria), V. Adasko, V. Balebanov, and A. Iosifian (Akademiia Nauk SSSR, Institut Kosmicheskikh Issledovanii, Moscow, USSR). *International Astronautical Federation, International Astronautical Congress, 32nd, Rome, Italy, Sept. 6-12, 1981, Paper 81-212.* 10 p.

The instrumentation for the Intercosmos-Bulgaria-1300 program to study ionospheric and magnetospheric interactions is described. Scientific objectives and observations such as regularities in the appearance of localized regions of electric fields and excitation

mechanisms on stable auroral red arcs are discussed, and a table of measurement parameters and the respective instruments is given. Accuracies of 0.1% for the electric field and 0.002% for the magnetic field are expected. Fundamental space physics problems are covered, and the selection process of the most effective parameters for the satellite and its orbit is presented. Finally, the scientific payload, based on plasma, high-energy, electromagnetic and optical equipment systems is analyzed, including the Foton-1, which scans the UV spectrum between 110-260 nm, providing information for aeronomic studies and the identification of high-energy impact ionization processes. D.L.G.

A81-47409 First results of the Intercosmos satellite IK-21. K. Bischoff, E. Orlicek, K.-H. Schmelovsky, G. Zimmermann (Deutsche Akademie der Wissenschaften, Institut für Kosmosforschung, Berlin, East Germany), H.-J. Fischer (Gesellschaft für Weltraumforschung und Raumfahrt, East Germany), T. Hettenyi (Budapesti Muszaki Egyetem, Budapest, Hungary), G. Terekhin (Akademiia Nauk SSSR, Institut Kosmicheskikh Issledovanii, Moscow, USSR), and F. Wiegmann (Dresden, Technische Universität, Dresden, East Germany). *International Astronautical Federation, International Astronautical Congress, 32nd, Rome, Italy, Sept. 6-12, 1981, Paper 81-214.* 14 p.

First results of technical tests on the data collection system for Intercosmos-21 are presented, including results from multispectral measurements in the visual and NIR ranges. The general communication and electronics structures are given, and optical details of instruments are shown. Maximum power consumption during transmission is 14 W, with a mean power consumption of 1.5 W. The satellite consists of two channel receivers at 400 MHz, a transmitter at 460 MHz, two transmitters at 136 MHz, two magnetic recorders and control electronics. Depending on the geographical distribution of platforms, the number of suitable contacts and total contact time can be limited, and a time window is introduced to avoid erroneous transmissions during near horizontal passages. Results of the tests confirm calculations based on laboratory measurements, with a preliminary error rate of .0001, which agrees well with calculations based on measured receiver sensitivity 0.1 microvolts at 60 ohms. D.L.G.

A81-48331 A top-down approach to the use of simulation in computer system design. I. C. Anderson (IBM Corp., Raleigh, NC), L. E. Deimel, Jr., R. J. Fornaro, and D. F. McAllister (North Carolina State University, Raleigh, NC). In: Summer Computer Simulation Conference, Seattle, WA, August 25-27, 1980, Proceedings. Arlington, VA, AFIPS Press, 1980, p. 89-93. 5 refs.

The process used in the design of the Edit Processor (EP) component of the Integrated Photogrammetric Instrument Network (IPIN) is described; IPIN is a network of instrumentation and minicomputers being assembled by the Defense Mapping Agency Aerospace Center to produce a data base of digitized terrain information from aerial stereophotographs. The top-down refinement of the EP simulation model proved to be an effective flexible tool to accompany the successive-refinement design process. The use of the multiple-server simplication for determining gross parameters of a system such as the EP is especially attractive and warrants further study to quantify the scope of its usefulness. B.J.

A81-48553 * Advanced synthetic aperture radar for remote sensing. K. Krishen, T. K. Sampsel (NASA, Johnson Space Center, Experiment Systems Div., Houston, TX), and W. E. Brown, Jr. (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA). In: EASCON '80; Electronics and Aerospace Systems Conference, Arlington, VA, September 29-October 1, 1980, Conference Record. New York, Institute of Electrical and Electronics Engineers, 1980, p. 362-368. 5 refs.

A program initiated by NASA was formed to address some key earth resources synthetic aperture radar (SAR) needs. Major steps in the SAR system development are summarized, and the objective of the advanced SAR (ASAR) program is defined. The program rationale and specific objectives are discussed, including system calibration, wide-band technique evaluation, a system resolution of 10 m or better at 45 deg, and an airborne system to cover four bands within 1 to 10 GHz. The ASAR conceptual system design, consisting of a modulator, transmitter, antenna, receiver, calibrator, and data system modules is also presented, and ASAR capability expansions are discussed. The program, scheduled for 1983, will provide a data source which is not available to applications investigations at this time, and will produce design approaches that are flexible and multimission to the maximum extent for application to a Shuttle or a freeflyer system. D.L.G.

A81-48689 # The characteristics of combining devices with different survey bands aboard a satellite (Osobennosti kompleksirovaniia na bortu ISZ priborov s razlichnymi polosami obzora). A. A. Astashkin, V. K. Saul'skii, and G. R. Uspenskii. *Issledovanie Zemli iz Kosmosa,* July-Aug. 1981, p. 66-69. In Russian.

Several devices, having different resolutions and survey bands, are combined aboard satellites for the remote sensing of earth resources. A method is presented for calculating the satellite orbital parameters which will allow a complete coverage of the earth by each of the bands individually. Three devices are considered: a scanning television system with a survey band of 800 km and a resolution of 200 m, a multispectral system with a survey band of 200 km and a resolution of 50 m, and a television system with a survey band of 50-100 km and a resolution of 25 m. The requirements for the accurate maintenance of orbital height needed to accomplish a multi-band global survey are also determined. J.F.

A81-48945 * Early results from Magsat. R. A. Langel (NASA, Goddard Space Flight Center, Geophysics Branch, Greenbelt, MD), R. H. Estes, and M. A. Mayhew (Business and Technological Systems, Inc., Seabrook, MD). *Nature,* vol. 293, Sept. 17, 1981, p. 190-192.

Papers presented at the May 27, 1981 meeting of the American Geophysical Union concerning early results from the Magsat satellite program, which was designed to study the near-earth magnetic fields originating in the core and lithosphere, are discussed. The satellite was launched on October 30, 1979 into a sun-synchronous (twilight) orbit, and re-entered the atmosphere on June 11, 1980. Instruments carried included a cesium vapor magnetometer to measure field magnitudes, a fluxgate magnetometer to measure field components and an optical system to measure fluxgate magnetometer orientation. Early results concerned spherical harmonic models, fields due to ionospheric and magnetospheric currents, the identification and interpretation of fields from lithospheric sources. The preliminary results confirm the possibility of separating the measured field into core, crustal and external components, and represent significant developments in analytical techniques in main-field modelling and the physics of the field sources. A.L.W.

A81-49134 * Satellite oceanography - The instruments. R. H. Stewart (California Institute of Technology, Jet Propulsion Laboratory, Pasadena; California, University, Scripps Institution of Oceanography, La Jolla, CA). *Oceanus,* vol. 24, Fall 1981, p. 66-74. NASA-supported research.

It is pointed out that no instrument is sensitive to only one oceanographic variable; rather, each responds to a combination of atmospheric and oceanic phenomena. This complicates data interpretation and usually requires that a number of observations, each sensitive to somewhat different phenomena, be combined to provide unambiguous information. The distinction between active and passive instruments is described. A block diagram illustrating the steps necessary to convert data from satellite instruments into oceanographic information is included, as is a diagram illustrating the operation of a radio-frequency radiometer. Attention is also given to the satellites that carry the various oceanographic instruments. C.R.

A81-49753 # The Surveillance Satellite Program and the future of microwave remote sensing. A. L. Vankoughnett (National Research Council, Canada Centre for Space Science, Ottawa, Canada), R. K. Raney (Canada Centre for Remote Sensing, Ottawa, Canada), and E. J. Langham (Environment Canada, Inland Waters Directorate, Hull, Quebec, Canada). In: Canadian Symposium on Remote Sensing, 6th, Halifax, Canada, May 21-23, 1980, Proceedings. Ottawa, Canadian Aeronautics and Space Institute, 1981, p. 9-16. 8 refs.

The principal elements of the Canadian Surveillance Satellite (Sursat) program were participation in the NASA Seasat satellite experiment and a complementary research and development program. The Sursat program demonstrated the capabilities of spaceborne radiometers, scatterometers, and altimeters to monitor weath-

er and sea state parameters such as ocean surface temperature, ocean surface wind speed and direction, and ocean wave height. It also demonstrated the possibility of producing high-resolution images of the earth from space using Seasat SAR and the possibility that such images could provide information required by operational agencies for monitoring of ice coverage and drift. This paper describes the Sursat program and its conclusions and speculates about future microwave remote sensing activities in Canada. B.J.

A81-49765 # **The airborne SAR project - Conclusions and applications.** D. R. Inkster, R. T. Lowry, N. A. Prout (Intera Environmental Consultants, Ltd., Ottawa, Canada), R. K. Raney, and K. P. B. Thomson (Canada Centre for Remote Sensing, Ottawa, Canada). In: Canadian Symposium on Remote Sensing, 6th, Halifax, Canada, May 21-23, 1980, Proceedings. Ottawa, Canadian Aeronautics and Space Institute, 1981, p. 119-126. 7 refs.

The extensive set of SAR imagery produced during the Airborne SAR Project (ASP) is examined along with some general research results. Maps of image areas are presented; data quality is examined; and the accessibility of the data to the public for future work is described. Results from the ice, oceans, lands, and human activities experiments are reviewed. Particular attention is given to ice surveillance research, including two recently completed industry-government pilot projects. B.J.

A81-49801 # **Benefits of using airborne remote sensing for Thematic Mapping.** R. A. Ryerson (Canada Centre for Remote Sensing, Ottawa, Canada). In: Canadian Symposium on Remote Sensing, 6th, Halifax, Canada, May 21-23, 1980, Proceedings. Ottawa, Canadian Aeronautics and Space Institute, 1981, p. 493-500. 5 refs.

Preliminary results of the benefit-cost analysis now being done on the CCRS Airborne Remote Sensing Program are presented. Using material verified by users, the analysis demonstrates that Airborne Remote Sensing (ARS) is often a cost-effective and accurate source of data. What is more, ARS provides a permanent record which can be consulted for additional interpretation long after imaging. A comparison is made between 1:10,000 panchromatic and 1:60,000 CIR with respect to user/industry supplied acquisition costs, interpretation costs, number of images, and total cost of mapping a hypothetical area using new and archived CIR and panchromatic film. In every case, the CIR was found to cost less. Significant specific benefits are illustrated using examples of imagery, dollar benefits of the use of remote sensing are calculated, and nonquantifiable results are described. C.R.

N81-29408*# National Aeronautics and Space Administration. Wallops Flight Center, Wallops Island, Va.
ALTIMETER RAIN DETECTION Final Report
E. J. Walsh Jul. 1981 19 p refs
(NASA-TM-73291) Avail: NTIS HC A02/MF A01 CSCL 14B

The implementation of a rain detection capability for the NOSS Radar altimeter design is proposed which would require only minor hardware modifications to the Seasat altimeter design is proposed. The expected level of performance is indicated. A.R.H.

N81-29480*# California Univ. at Los Angeles. Inst. of Geophysics and Planetary Physics.
GEOMAGNETIC FIELD MAPPING FROM A SATELLITE: SPATIAL POWER SPECTRA OF THE GEOMAGNETIC FIELD AT VARIOUS SATELLITE ALTITUDES RELATIVE TO NATURAL NOISE SOURCES AND INSTRUMENT NOISE

M. G. McLeod and P. J. Coleman, Jr. *In* Alabama Univ. UAH/NASA Workshop on the Use of a Tethered Satellite System May 1976 5-32 refs

(Publ-1810) Avail: NTIS HC A11/MF A01 CSCL 08G

The spectra for the field are presented together with power spectra of the natural magnetospheric and ionospheric noise and a power spectrum of instrumental noise for a typical fluxgate magnetometer. The source of these data is described. The implications of these data relative to desirable instrument frequency resonse, stability and resolution specification as well as the implications relative to desirable spacecraft position and orientation accuracy specifications and desirable environmental (temperature, magnetic noise) specifications are discussed. Implications of these power spectra relative to choice of a suitable magnetometer and relative to desirable methods of data processing are considered. Finally, implications for desirable orbit and mission duration are discussed. T.M.

N81-29482*# Phoenix Corp., McLean, Va.
REDUCTION AND ANALYSIS OF SATELLITE MAGNETOMETER DATA
Robert D. Regan *In* Alabama Univ. UAH/NASA Workshop on the Use of a Tethered Satellite System May 1978 p 59-91 refs Submitted for publication

Avail: NTIS HC A11/MF A01 CSCL 08N

The broad-scale magnetic anomalies that appear in regional complications of aeromagnetic data, and in regional and global maps are discussed. Satellite data can be of value in defining such anomalies and invaluable, especially when utilized with airborne data, in their interpretation. The reduction and interpretation of satellite magnetometer data differ significantly from the standard techniques that are routinely applied to conventional measurements. The reduction of the data is discussed and its morphology is detailed. Interpretational techniques that are applicable are presented. T.M.

N81-29512# *Defense Mapping Agency Aerospace Center, St. Louis, Mo.* Dept. of Aerospace Cartography.
THE SENSOR IMAGE SIMULATOR Interim Report, Oct. 1979 - May 1981
Marshall B. Faintich, Paul C. Figura, and E. W. Quinn (Goodyear Aerospace Corp., Akron, Ohio) 22 Jun. 1981 21 p refs Proposed for presentation at the 3rd Iterservice/Ind. Training Equipment Conf., Orlando, Fla., 30 Nov. - 2 Dec. 1981
(AD-A101172) Avail: NTIS HC A02/MF A01 CSCL 09/2

The primary objective of the digital sensor simulation investigations being conducted at the Defense Mapping Agency (DMA) is to establish an editing and analysis capability for the digital culture and terrain data bases. For purposes of quality control and data base applicability investigations, DMA has developed the Sensor Image Simulator (SIS), a very high speed data base edit station and static scene simulator that allows for interactive query and manipulation of individual features in the data base displays and/or simulated sensor scenes to determine the corresponding data base elements responsible for the simulated features. The SIS was installed at DMA in 1981, and is designed to play a key role in determining the applicability of prototype data bases for use in advanced training simulators, as well as to ensure the quality of, and coherence between, the various digital data bases prior to new data insertion into the master cartographic data base files. Author (GRA)

N81-30325*# National Aeronautics and Space Administration. Wallops Flight Center, Wallops Island, Va.
RADAR ALTIMETER WAVEFORM MODELED PARAMETER RECOVERY
Aug. 1981 59 p refs
(NASA-TM-73294) Avail: NTIS HC A04/MF A01 CSCL 17I

Satellite-borne radar altimeters include waveform sampling gates providing point samples of the transmitted radar pulse after its scattering from the ocean's surface. Averages of the waveform sampler data can be fitted by varying parameters in a model mean return waveform. The theoretical waveform model used is described as well as a general iterative nonlinear least squares procedures used to obtain estimates of parameters characterizing the modeled waveform for SEASAT-1 data. The six waveform parameters recovered by the fitting procedure are: (1) amplitude; (2) time origin, or track point; (3) ocean surface rms roughness; (4) noise baseline; (5) ocean surface skewness; and (6) altitude or off-nadir angle. Additional practical processing considerations are addressed and FORTRAN source listing for subroutines used in the waveform fitting are included. While the description is for the Seasat-1 altimeter waveform data analysis, the work can easily be generalized and extended to other radar altimeter systems. A.R.H.

N81-30342# Universite Catholique de Louvain (Belgium). Lab. de Telecommunications et d'Hyperfrequences.
STUDY OF THE INFLUENCE OF THE ATMOSPHERE ON THE PERFORMANCE OF AN IMAGING MICROWAVE RADIOMETER

A. Guissard Paris ESA Jul. 1980 248 p refs
(Contract ESTEC-4124/79/NL-DG(SC))
(ESA-CR(P)-1421) Avail: NTIS HC A11/MF A01

Errors induced by the intervening atmosphere on the determination of ground parameters from a set of radiometers operating in two polarization states and in the frequency range from 5 to 90 GHz were analyzed. The precision with which the atmospheric parameters themselves are measurable was studied. Methods for estimating parameters from measurements performed in a noisy environment are discussed. The radiative transfer problem through a scattering medium is reviewed and an approximate scalar form of the radiative equation proposed, valid under the assumption that the depolarizing effect can be neglected. A complete model for the atmosphere is discussed, and analytical expressions for the attenuations from atmospheric gases, clouds and rain are given for the frequency range of interest. Models for the radiative behavior of sea and sea ice are discussed. Finally the performance of the multichannel radiometer is analyzed for several typical situations. Author (ESA)

N81-32595# Zeiss (Carl), Oberkochen (West Germany). Abt. fuer Geodaesie und Photogrammetrie.
APPLICATION OF NEW PRECISION MEASURING SYSTEMS FOR PHOTOGRAMMETRIC COMPARATORS Final Report
Reiner Schwebel Bonn Bundesministerium fuer Forschung und Technologie Dec. 1980 23 p refs In GERMAN; ENGLISH summary Sponsored by Bundesministerium fuer Forschung und Technologie
(BMFT-FB-T-80-134; ISSN-0340-7608) Avail: NTIS HC A02/MF A01

A technique for high precision two-dimensional coordinates measurements was developed and led to the construction of a high precision comparator. The system is based on Abbe's comparator principle makes use of a precision metrological x-y grid and linear pulse generators, and is free of mechanical driving error. The maximum error of scale, coordinate system and interpolation unit is below 0.5 microns and the temperature dependence attains at most 0.5 microns per degree C. A computer interface permits such online applications as controlled aerotrian gulation or multiple photogrammetry in astronomy and industry. Author (ESA)

N81-33340# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany). Inst. fuer Hochfrequenztechnik.
INTRODUCTION TO THE WORKSHOP
A. Sieber *In* ESA Coherent and Incoherent Radar Scattering from Rough Surfaces and Vegetated Areas May 1981 p 13-17 refs
Avail: NTIS HC A08/MF A01

Research objectives in the use of scatterometers and imaging radar systems are discussed. System design for scatterometers and imaging radars, differences between scatterometers and imaging radars with respect to the measurement of scattered energy, and processing and evaluation of scatterometer data are included. Suggestions for work on theoretical models are given. These topics are related to data evaluation of synthetic aperture radar. Author (ESA)

N81-33540*# EG & G Washington Analytical Services Center, Inc., Riverdale, Md. Applied Systems Dept.
A STUDY OF THE EFFECTS OF THE ATMOSPHERE ON THEMATIC MAPPER OBSERVATIONS
William A. Pearce, Principal Investigator 1 Oct. 1977 139 p refs ERTS
(Contract NAS5-23639)
(E81-10056; NASA-CR-166660; EGG-004-77) Avail: NTIS HC A07/MF A01 CSCL 08B

The impact of Rayleigh and aerosol light scattering and the scattering of light by the ground both within and beyond the instantaneous field of view of the sensor are included in a Monte Carlo computer code used to simulate the transport of radiation from its source (the Sun) to satellite-borne receivers. The problem of signature contamination by atmospheric scattering is addressed. The specifications of the details of the computer code and of the model for the atmosphere-Earth-receiver system are described. Specifications of the thematic mapper scheduled to be launched on LANDSAT-D are summarized. Model observations of ground patterns and calibration effects are discussed. General formalism, spread and modulation transfer functions, and image enhancement are considered. The impact of the atmosphere on classification and classification errors is examined. Recommendations are included. A.R.H.

09
GENERAL

Includes economic analysis.

A81-42231 **Environmental satellites.** E. P. McClain (NOAA, National Earth Satellite Service, Washington, DC). In: McGraw Hill encyclopedia of environmental science. New York, McGraw Hill Book Co., Inc., 1980. 16 p. 13 refs.

The meteorological and oceanographic applications of the Geostationary Operational Environmental Satellite (GOES) and Improved TIROS Operational Satellite (ITOS) are discussed. Brief descriptions of the satellites, including the solar activity monitors and data collection systems are given. Meteorological applications involve disaster warning, frost forecasting, search and rescue, and snow cover information. Oceanographic applications both in operations and research, include sea surface temperatures to aid oil tankers along the eastern seaboard, upwelling processes, ocean current systems, and ice mapping. Other spacecraft for meteorological and environmental studies launched by NASA are the Landsat 3, designed for high resolution, Nimbus 7, equipped with imagers and sounders, and Seasat 1, used for observations of the oceans. D.L.G.

A81-42287 # **Efficiency criteria of space systems for studying the earth's natural resources (Kriterii effektivnosti kosmicheskikh kompleksov dlia izucheniia prirodnykh resursov zemli).** V. S. Avduevskii, A. A. Astashkin, V. K. Saul'skii, and G. R. Uspenskii. *Issledovanie Zemli iz Kosmosa,* May-June 1981, p. 89-95. 11 refs. In Russian.

Criteria for evaluating the efficiency of space systems, used to study the earth's natural resources, are discussed. The procedure is based on the determination of additional user income gained from the application of the space system: costs of design, development, and operation; and values characterizing the ability of the system to complete the user tasks. The approach is illustrated by values projected for Landsat-D. J.F.

A81-42288 # **Main tasks and methods of operational planning of experiments concerning the observations of the earth from space (Osnovnye zadachi i metody operativnogo planirovaniia eksperimentov po issledovaniiu zemli iz kosmosa).** M. Iu. Beliaev. *Issledovanie Zemli iz Kosmosa,* May-June 1981, p. 96-101. 5 refs. In Russian.

The effective operational planning of geophysical experiments, involving the use of manned spacecrafts for the remote sensing of earth resources, is discussed. Operational planning is considered as one of the tasks of the overall control of a complex space system and can be reduced to several individual tasks. The proposed solution of the problems is performed in an interactive mode, and an algorithm for the operational planning of geophysical experiments is presented. J.F.

A81-42513 **Large scale human benefits of space industrialization.** C. L. Gould (Rockwell International Corp., Pittsburgh, PA). In: Update on space. Volume 1. Granada Hills, CA, National Behavior Systems, 1981, p. 30-63.

Space industrialization is defined as a new technology in which the special environmental properties of outer space are used for the social and economic benefit of the people of the earth. A study conducted in connection with a NASA Contract on Space Industrialization is discussed. Part One of this study identified the potential goals for space industrialization and looked at ways to realize those goals. Part Two was concerned with the programs and problems of actually bringing about the goals. Space can be used to provide very large scale benefits either supported by the government in public services, supported by private industry or some combination thereof. World problems related to the population explosion are considered and attractive opportunities gained from space are discussed. These opportunities can be divided into four categories, related to services, products, energy, and human activities. G.R.

A81-43535 **Skylab *in retrospect*.** E. E. Derenyi (New Brunswick, University, Fredericton, Canada). *Photogrammetric Engineering and Remote Sensing,* vol. 47, Apr. 1981, p. 495-499. 7 refs.

Investigations conducted at the University of New Brunswick into the accuracy attainable for horizontal control extension using Skylab/EREP S-190A and S-190B imagery are reviewed. Single image and multiple image processing are discussed and it is shown that simple space resection procedures can give results compatible with more sophisticated aerial triangulation techniques. The RMSE values in X and Y coordinates ranged from 35 m to 75 m for S-190A photography and was on the order of 20 m photography for the S-190B imagery. The results obtained and the experience gained form a basis for predictions and recommendations pertinent to future space photography missions. In particular, the expected performance of the Large Format Camera, proposed for use in the Space Shuttle missions of the early 1980's, is discussed. (Author)

A81-43750 **Landsat technology transfer to the private and public sectors through community colleges and other locally available institutions.** R. H. Rogers, C. L. Wilson, R. H. Dye (Michigan, Environmental Research Institute, Ann Arbor, MI), and E. Jaworksi (*Eastern Michigan University, Ypsilanti, MI*). *In: Rainbow 80; Fall* Technical Meeting, Niagara Falls, NY, October 7-10, 1980, ASP Technical Papers. Falls Church, VA, American Society of Photogrammetry, 1981, p. PS-2-C-1 to PS-2-C-13. 5 refs.

NASA transferred Landsat technology to practicing professionals in the private sectors through community colleges and other locally available institutions. 'Hands on' interactive analysis training and demonstrations are offered through the use of color desk-top computer terminals communicating with a host computer by telephone lines. Features of the terminals and associated training materials are reviewed, including low cost, portability, interactive control, and special display features. Operational steps used to process Landsat data are enumerated. Plans for the of use of these features in training and demonstration projects are discussed. Results of the transfer project show that a gradual expansion of the user facility can be expected as confidence and available capital increase, and as the system shows potential for easily merging other sources of data into the Landsat analysis process. J.F.

A81-43981 # **Aerial thermal survey in the study of earth resources (Teplovaia aeros'emka pri izuchenii prirodnykh resursov).** B. V. Shilin. Leningrad, Gidrometeoizdat, 1980. 248 p. 119 refs. In Russian.

The principles of the thermal or infrared aerial surveying of earth resources are presented. Particular consideration is given to the operation of thermal sensors and to the selection of optimum survey conditions. Various applications of this technique are considered, including the study of anomalous temperature fields, geological mapping, the study of water bodies, the investigation of snow and ice cover, and hydrological and hydrogeological surveys. B.J.

A81-44635 **Commercial operations in space - 1980-2000; Proceedings of the Eighteenth Goddard Memorial Symposium, Washington, DC, March 27, 28, 1980.** Symposium sponsored by AAS, AIAA, AMA, et al. Edited by J. L. McLucas (Communications Satellite Corp., Washington, DC) and C. Sheffield (Earth Satellite Corp., Washington, DC). San Diego, CA, American Astronautical Society (*Science and Technology Series. Volume 51*); Univelt, Inc., 1981. 211 p. $30.

The need to revitalize American industry is considered along with questions of space industrialization, materials science and engineering in space, materials engineering in space, space power systems, earth resources, commercial launch operations, research opportunities, and international opportunities. Attention is given to the Space Shuttle power extension package, the orbital transfer of large space structures with nuclear electric rockets, a satellite power system overview of system studies and critical technology, electric orbit transfer vehicles, the mixed-mode principle and advanced chemical rocket engine concepts, crop reporting from space, the Space Industrialization Act and the government role in the commercialization of space, the airlines in the 80's and 90's, approaches to private sector involvement with government in technology development, innovation of space technology through joint endeavors between NASA and private industry, and the economic and political climate for exploitation of space riches. G.R.

A81-46234 # **European industrial space projects.** G. C. Bernardini (Italeco S.p.A., Rome, Italy). *American Astronautical Society, Goddard Memorial Symposium on International Space Technical Applications, 19th, Arlington, VA, Mar. 26, 27, 1981, Paper 81-053.* 8 p.

The efforts of an Italian civil engineering firm (ITALECO S.p.A.) to profitably use Landsat data are recounted. The data did not bring the commercial benefits hoped for, primarily because of the absence of repeatable and reliable rules for converting the esoteric art of Landsat interpretation into science and engineering practice. At present, the only role for Landsat, from a commercial viewpoint, is that of a source with which to supplement the information available from standard methods. C.R.

A81-46238 # **Development of Marine Observation Satellite-1.** K. Matsumoto (National Space Development Agency of Japan, Earth Observation Systems Dept., Tokyo, Japan). *American Astronautical Society, Goddard Memorial Symposium on International Space Technical Applications, 19th, Arlington, VA, Mar. 26, 27, 1981, Paper 81-060.* 9 p.

The program of MOS-1, the first Japanese earth observation satellite system to be developed for experimental purposes, is outlined. The mission objectives are to establish fundamental technologies common to both marine and land observation satellites, observe the sea surface and atmosphere using visible, infrared, and microwave radiometers, and verify the performance of these sensors. A table giving the characteristics of the MOS-1 sensors is included, and the data collection system transponder is described. Also included is a schematic diagram of the MOS-1 communication system. The various systems making up the ground segment are also described. C.R.

A81-47346 **SPOT status of development.** M. Courtois (Centre National d'Etudes Spatiales, Toulouse, France). *International Astronautical Federation, International Astronautical Congress, 32nd, Rome, Italy, Sept. 6-12, 1981, Paper 81-92.* 11 p.

The System Probatoire d'Observation de la Terre (SPOT), a general purpose remote sensing satellite system, will be launched in May, 1984 within the French National Space Program. The SPOT mission objectives include the compilation of a worldwide data base for cartographic and earth resource exploration purposes, improvements in vegetative species discrimination, and the evaluation of photointerpretation methods and the linear array camera in space. The SPOT satellite consists of the SPOT 'bus', a standard multipurpose platform, and the payload; it will weigh 1750 kg at the start of the mission and operate in a circular sun-synchronous near-polar orbit at an altitude of 832 km. The HRV (high resolution visual) instrument is designed to operate in either a panchromatic mode (broad spectral band) with a ground sampling mesh of 10 m x 10 m or a multispectral mode (three narrower color bands) with a ground sampling mesh of 20 m x 20 m. This flexibility will enable the specific target scenes to be sampled more frequently as well as provide for stereo coverage of important areas. Linear arrays of CCD detectors will combine a high data rate (25 m bits/sec/data channel) with good radiometric resolution. Data from the satellite will be accessible through the central facility in France or through authorized X-band direct read-out stations. J.F.

A81-47350 **Physical and technical foundations for the development of subsatellite systems for the exploration of natural earth resources.** T. K. Ismailov (Akademiia Nauk Azerbaidzhanskoi SSR, Institut Kosmicheskikn Issledovanii Prirodnykh Resursov, Baku, Azerbaidzhan SSR). *International Astronautical Federation, International Astronautical Congress, 32nd, Rome, Italy, Sept. 6-12, 1981, Paper 81-101.* 10 p. 5 refs.

The importance of organizing a subsatellite environmental service is stressed. The principal objective of this service would be the prompt and regular collection, processing, and transmission of the results obtained from both contact and remote measurements of a large number of physicochemical, biometric, optical, and geometric characteristics of natural objects. The measurements would be taken at specified control points on the earth's surface using observation and measurement platforms (air, continental, and marine) either synchronously or quasi-synchronously with space facilities. C.R.

A81-47355 **Soviet remote sensing of the earth's resources and interpretation of space data with reference to the Caspian Sea, Siberia and the Arctic Ocean.** J. Popescu (British Broadcasting Corp., Monitoring Service, Reading, Berks., England). *International Astronautical Federation, International Astronautical Congress, 32nd, Rome, Italy, Sept. 6-12, 1981, Paper 81-112.* 8 p. 11 refs.

Soviet remote sensing of the earth's resources, including population, by unmanned and manned satellites is discussed. Multiscanning equipment is described, and it is noted that photographs and remote sensing data are used for making maps, prospecting, research, farming, civil engineering, weather forecasting, and protecting the environment. Attention is given to the increased importance of the data transmitted by crews on board the Salyut-6 space lab. C.R.

A81-47826 **What does space remote sensing provide (Qu'apporte la télédétection spatiale).** P. Gonfreville (Centre National d'Etudes Spatiales, Paris, France). *L'Aéronautique et l'Astronautique,* no. 89, 1981, p. 3-20. In French.

The capabilities and advantages of space remote sensing in the gathering of data for the management of natural resources and national development are discussed. The principles and operational characteristics of space remote sensing are considered with particular reference to the Landsat and SPOT systems. Attention is then given to specific applications of space remote sensing in the fields of cartography, including topographic and thematic mapping, agriculture, including national agricultural statistics, crop prediction and agricultural management, forests and natural vegetation, inland water resources, regional management for economic and social development, mineral and petroleum exploration, oceanography and other types of large inventories. A.L.W.

A81-47829 **Evaluation of the 1980 Cosmos program (Bilan du programme Cosmos 1980).** D. Laurent. *L'Aéronautique et l'Astronautique,* no. 89, 1981, p. 44-50. In French.

In the year 1980, the Soviet Union effected 89 rocket launches sending into orbit 110 satellites. The present paper examines the 88 of these satellites not launched as part of specific space programs but within the framework of the diversified Cosmos program. Of the 78 satellites launched for military applications, 30 were for purposes of photographic reconnaissance, 25 were for telecommunications, seven for navigation, five for electronic surveillance, five for early warning, three for ocean surveillance and three for interception. Six satellites for civilian applications were launched: four for purposes of earth resource detection and two Molniya satellites unable to be placed in their desired orbits. Four Cosmos satellites were sent up with scientific missions, including ocean observations, and geophysical experiments. As to general trends over the last five years, 1980 witnessed an increase in space activities compared to the previous year, continuing emphasis on the military sector and a preference for orbital inclinations of 72.9 and 82.3 deg. A.L.W.

A81-48527 **Requirements on the data/information system.** R. Bernstein (IBM Scientific Center, Palo Alto, CA). In: EASCON '80; Electronics and Aerospace Systems Conference, Arlington, VA, September 29-October 1, 1980, Conference Record.

New York, Institute of Electrical and Electronics Engineers, 1980, p. 20-26. 6 refs.

The paper examines current problems concerning the development and implementation of satellite systems of earth observation, and suggests some approaches and solutions for the future that involve software, system, and data standardization, and the development of a global digital data base. Advanced sensors produce digital data at rates of tens of millions of bits per second; communication systems exist that are capable of disseminating the data on a worldwide basis at millions of bits per second; and ground processing systems are currently operational that are preprocessing the sensor data and making them available to the user community. It is likely that future problems will involve managing the acquisition and distribution of these data, and providing the data to the users in a timely manner, in a suitable form, and at the lowest possible cost. B.J.

A81-48549 **The SPOT satellite mission, applications aspects and data products.** J.-P. Fouquet (Ambassade de France aux Etats Unis, Washington, DC). In: EASCON '80; Electronics and

Aerospace Systems Conference, Arlington, VA, September 29-October 1, 1980, Conference Record. New York, Institute of Electrical and Electronics Engineers, 1980, p. 306, 307.

A brief description of the SPOT satellite system is given. It is pointed out that the first mission's (1984) payload will comprise two identical optical instruments, which are described in detail, two onboard recorders, and an image telemetry system at 8 GHz (X-band). The SPOT system will be used mainly in cartography, geology, and agriculture. With regard to cartography, it is noted that the telescopes, because they can be pointed, will provide the cartographic user with a capability for quasi-vertical coverage and slant or stereo coverage. In geology, stereo data will be very useful in the reconnaissance exploration for the study of geomorphic features. In agriculture, the system's ground resolution will enable agricultural users to control small fields or to use SPOT data as samples for Landsat D data with which compatibility is studied. Tables giving the characteristics of the system's first payload and standard SPOT products are included. C.R.

A81-48936 **Remote sensing in development.** C. K. Paul (U.S. Agency for International Development, Washington, DC) and A. C. Mascarenhas (Dar es Salaam, University, Dar es Salaam, Tanzania). *Science*, vol. 214, Oct. 9, 1981, p. 139-145. 12 refs.

It is pointed out that in developing countries remote sensing is used to acquire statistics on crops and to locate petroleum and mineral deposits. To an ever greater extent, it is also being used for forest monitoring and subsurface water location. Among the problems related to Third World use of the technology are sensitivity about the dissemination of data with high spatial resolution, exploitation by multinational companies, absorptive capacity of countries for advanced technology, autonomy in acquiring resource information, and competing foreign policy interest of the industrialized world in the global search for raw materials. The attitude of Third World countries toward the use of remote sensing is seen as depending on the development model they adopt. C.R.

A81-49468 # **International monitoring from space /Problems of international law/ (Mezhdunarodnyi kontrol' s ispol'zovaniem kosmicheskikh sredstv /Mezhdunarodno-pravovye problemy/).** I. I. Kotliarov. Moscow, Izdatel'stvo Mezhdunarodnye Otnosheniia, 1981. 120 p. 232 refs. In Russian.

The work considers various aspects of monitoring and surveillance with regard to international laws and agreements on environment protection, disarmament, the use of space, etc. The use of spacecraft for purposes of such monitoring is discussed in detail. B.J.

A81-49751 ***Canadian Symposium on Remote Sensing, 6th*, Halifax, Canada, May 21-23, 1980, Proceedings.** Symposium sponsored by CASI, Canada Centre for Remote Sensing, Environment Canada, et al. Edited by T. T. Alfoldi (Canada Centre for Remote Sensing, Ottawa, Canada). Ottawa, Canadian Aeronautics and Space Institute, 1981. 715 p. In English and French.

Aspects of remote sensing technology and operational experience are reviewed, with reference to Canadian Programs. Particular attention is given to such applications as land use, forestry, agriculture, geology, hydrology, and pollution monitoring. A special section is devoted to radar (particularly SAR) applications and technology. B.J.

A81-49762 # **The remote sensing satellite program of the European Space Agency (Le programme de satellites de télédétection de L'Agence Spatiale Européenne).** D. Breton (ESA, Earth Observation Programme Office, Toulouse, France). In: Canadian Symposium on Remote Sensing, 6th, Halifax, Canada, May 21-23, 1980, Proceedings. Ottawa, Canadian Aeronautics and Space Institute, 1981, p. 89-96. In French.

The main directions of ESA activities in remote sensing are: the Earthnet program; remote sensing activities that will be implemented during the first Spacelab mission; and project definition, system studies of instruments, and technological activities relating to the ESA remote sensing satellite program. This paper examines the ESA remote sensing satellite program; attention is given to the objectives of the program, the Canadian Sursat requirements, the results of past studies, and ongoing or projected activities. B.J.

A81-49763 # **Present state of remote sensing development in Poland.** J. Konieczny and A. Linsenbarth (Instytut Geodezji i Kartografii, Warsaw, Poland). In: Canadian Symposium on Remote Sensing, 6th, Halifax, Canada, May 21-23, 1980, Proceedings. Ottawa, Canadian Aeronautics and Space Institute, 1981, p. 97-101.

A brief description is presented of the development of remote sensing in Poland as well as of the main aims and achievements of the Polish Center for Remote Sensing (OPOLIS). The instrumentation system of OPOLIS is reviewed, and various applications of remote sensing in Poland are examined, including land use mapping, agriculture, forest surveys, water pollution studies, air pollution studies, disaster surveying, and geological surveys. B.J.

N81-31030# Committee on Science and Technology (U. S. House).

NASA AUTHORIZATION, 1982, VOLUME 4

Washington GPO 1981 1248 p Hearings before the Subcomm. on Space Sci. and Appl. of the Comm. on Sci. and Technol., 97th Congr., 1st Sess., No. 7, 28 Jan., 20, 23, 27 Feb., and 2, 4-5, 10-11 Mar. 1981

(GPO-79-432-Vol-4) Avail: Subcommittee on Space Science and Applications

Progress and accomplishments of the year are reviewed and requests for funding are examined in the areas of space sciences, shuttle related activities, space flight operations, a space applications, and aeronautics. The numerical aerodynamics simulation which will reduce the cost of aircraft design, chemical propulsion, large space structures, power systems, information systems, and the Venus Orbiting Imaging Radar spacecraft are discussed. Space processing, Spacelab payloads, and possible space shuttle configurations are also examined. A.R.H.

N81-32086*# Denver Research Inst., Colo. Program for Transfer Research and Impact Studies.

SPACE BENEFITS: THE SECONDARY APPLICATION OF AEROSPACE TECHNOLOGY IN OTHER SECTORS OF THE ECONOMY

[1981] 240 p refs

(Contract NASw-3113)

(NASA-CR-164733) Avail: NTIS HC A11/MF A01 CSCL 05A

Some 585 examples of the beneficial use of NASA aerospace technology by public and private organizations are described to demonstrate the effects of mission-oriented programs on technological progress in the United States. General observations regarding technology transfer activity are presented. Benefit cases are listed in 20 categories along with pertinent information such as communication link with NASA; the DRI transfer example file number; and individual case numbers associated with the technology and examples used; and the date of the latest contract with user organizations. Subject, organization, geographic, and field center indexes are included. A.R.H.

N81-32564*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

FIELD STUDY FOR REMOTE SENSING: AN INSTRUCTOR'S MANUAL

William H. Wake, ed. (California State Coll., Bakersfield) and Garth A. Hull, ed. 1981 93 p refs Proceedings of the LANDSAT C Educator's/User's Workshop, Santa Maria, Calif., 2-4 Mar. 1978; sponsored by the National Council for Geographic Education and Univ. of Western Illinois, Macomb

(NASA-CP-2155; A-8336; LC-78-61696) Avail: NTIS HC A05/MF A01 CSCL 05I

The need for and value of field work (surface truthing) in the verification of image identification from high atitude infrared and multispectral space sensor images are discussed in this handbook which presents guidelines for developing instructional and research procedures in remote sensing of the environment.

N81-32565*# International Business Machines Corp., White Plains, N.Y. General Business Group.

AN INDUSTRIAL PERSPECTIVE OF THE LANDSAT OPPORTUNITY

Barbara F. Williams *In* NASA. Ames Research Center Field Study for Remote Sensing 1981 p 1-3

Avail: NTIS HC A05/MF A01 CSCL 05B

The feasibility of enhancing LANDSAT products to provide the greatest usability low cost data possible can be determined through government sponsorship and finance of one or more task forces composed of a critical number of experts in multiple disciplines from many industries and academia. The synergism of multiple minds addressing singular problems without the creation of permanent or perpetual structures must yield output in the form of implementable specifications, even if presented as alternatives. Changes are needed within the spacecraft in order to account for Sun angle changes. The use of pointing accuracy to make geometric corrections (and possible radiometric corrections, is needed more than onboard data reduction and information extraction, which assume a proper knowledge of application and reduce potential utilization. Multilinear arrays need to be investigated and methods for sensor calibration and for determining the effects of atmospheric inversion, as well as the best way to back out the modulation transfer function must be determined. A.R.H.

N81-32566*# California State Coll., Bakersfield. Dept. of Physics and Earth Sciences.
THE WORKSHOP
William H. Wake *In* NASA. Ames Research Center Field Study for Remote Sensing 1981 p 5-7

Avail: NTIS HC A05/MF A01 CSCL 05B
The plan is presented for a two day workshop held to provide educational and training experience in the reading, interpretation, and application of LANDSAT and correlated larger scale imagery, digital printout maps, and other collateral material for a large number of participants with widely diverse levels of expertise, backgrounds, and occupations in government, industry, and education. The need for using surface truth field studies with correlated aerial imagery in solving real world problems was demonstrated. A.R.H.

N81-32567*# California State Coll., Bakersfield. Dept. of Physics and Earth Science.
WHY SURFACE-TRUTH FIELD STUDY IS NEEDED IN REMOTE-SENSING INSTRUCTION
William H. Wake *In* NASA. Ames Research Center Field Study for Remote Sensing 1981 p 9-15 ref

Avail: NTIS HC A05/MF A01 CSCL 05I
Especially designed field studies are needed in remote sensing technology transfer courses regardless of the field work provided by the students'/trainees' major disciplines because the remote sensing discipline has unique emphases and needs. Modification of existng schedules to include field work provides the equivalent of extending the duration of the program with the added benefit of enhancing learning achievements per actual program day. The process of surface truth field instruction, levels of student capabilities and stages in the development of surface truth field studies are discussed. A.R.H.

N81-32571*# Sonoma State Univ., Calif. Dept. of Geography.
LANDSAT C WORKSHOP FIELD/LABORATORY EXERCISES
Joseph W. Frasca *In* NASA. Ames Research Center Field Study for Remote Sensing 1981 p 45-59 refs

Avail: NTIS HC A05/MF A01 CSCL 05I
Collection of ground information and supportive materials are absolutely necessary to verify and substantiate data extracted by the interpretation process regardless of sensor type and scale. Field observation and notes, the use of topographic and thematic maps, crop calendars, and climate records are just four examples of supportive materials which often are used in conjunction with remotely sensed materials. Illustration of this integrated multisensor approach is provided by four examples from the March, 1978 Santa Maria LANDSAT C Conference and Workshop. Four distinctive window sites were selected to demonstrate the usefulness of remotely sensed materials to solve geographic problems. A.R.H.

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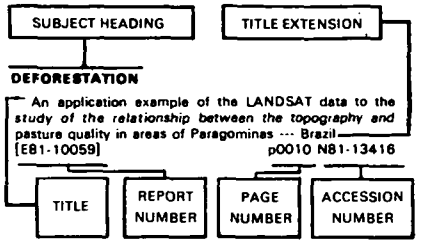

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A

B

C

D

E

F

G

H

I

J

K

L

M

N

O

P

Q

R

S

T

U

V

W

Y

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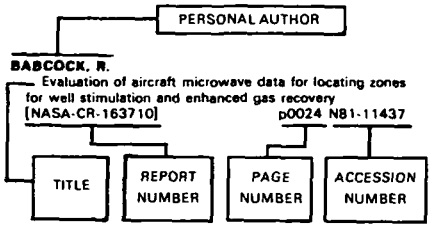

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A

B

C

D

E

F

G

H

I

J

K

L

M

N

O

P

Q

R

S

T

U

V

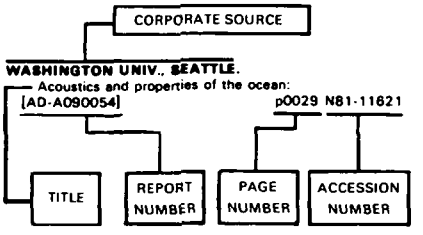
W

Y

Z

CORPORATE SOURCE INDEX

Typical Corporate Source Index Listing



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A

AEROSPACE CORP., EL SEGUNDO, CALIF.
Millimeter-wave sensing of the environment: A bibliographic survey
[NASA-CR-156879] p0219 N81-32581

AIR FORCE INST. OF TECH., WRIGHT-PATTERSON AFB, OHIO.
An evaluation of detail in dynamic visual displays
[AD-A103378] p0222 N81-33578

ANALYTIC SCIENCES CORP., READING, MASS.
Military geodesy and geospace science, unit one
[AD-A104038] p0222 N81-33581

APPLIED PHYSICS LAB., JOHNS HOPKINS UNIV., LAUREL, MD.
Spatial evolution of ocean wave spectra
p0235 A81-46112

ARIZONA UNIV., TUCSON.
Spectral properties of Arizona soils and rangelands and their relationship to LANDSAT digital data
p0207 N81-31595

ARKANSAS UNIV., FAYETTEVILLE.
Look direction dependence of radar backscattering cross section for agricultural fields p0199 A81-43741

Use of Seasat satellite radar imagery for the detection of standing water beneath forest vegetation
p0199 A81-43743

ARMY COASTAL ENGINEERING RESEARCH CENTER, FORT BELVOIR, VA.
Wave direction measured by four different systems
p0232 A81-42622

ARMY COLD REGIONS RESEARCH AND ENGINEERING LAB., HANOVER, N. H.
Survey of in-situ and remote sensing methods for soil moisture determination p0197 A81-43221

ARMY ENGINEER TOPOGRAPHIC LABS., FORT BELVOIR, VA.
Remote sensing for engineering site selection
[AD-A102810] p0219 N81-32586

Identifying igneous rocks in an arid environment on aerial photography by photo tone and photo texture
[AD-A102809] p0228 N81-32587

Landform-vegetation relationships in the northern Chihuahuan Desert
[AD-A102896] p0208 N81-32588

ATMOSPHERIC ENVIRONMENT SERVICE, DOWNSVIEW (ONTARIO).
Role of multiple scattering in ozone profile retrieval from satellite measurements in the ultraviolet
p0215 A81-45870

Investigation of multispectral remote sensing of snow cover using a solar radiation model p0262 A81-49804

B

BATTELLE INST., FRANKFURT AM MAIN (WEST GERMANY).
Experimental investigation of the physical fundamentals for remote sensing of soil and vegetation moisture by active infrared reflectance spectroscopy using CO2 laser technique
[BMFT-FB-W-80-037] p0211 N81-33588

BEDFORD INST. OF OCEANOGRAPHY, DARTMOUTH (NOVA SCOTIA).
Bay of Fundy verification of a system for multidate Landsat measurement of suspended sediment
p0250 A81-43254

BENDIX FIELD ENGINEERING CORP., GRAND JUNCTION, COLO.
Methods development and applications evaluations of NURE aerial reconnaissance survey data for uranium resource evaluation: Beeville/Bay City and Crystal City quadrangles, Texas
[GJBX-69(81)] p0228 N81-30502

BOSTON COLL., CHESTNUT HILL, MASS.
Requirements of space-borne microwave radiometers for detecting soil moisture contents p0270 A81-43225

BRITISH AEROSPACE DYNAMICS GROUP, BRISTOL (ENGLAND).
Coastal Oceans Monitoring Satellite System (COMSS) system evaluation study
[ESS/SS-1035] p0239 N81-30168

BUSINESS AND TECHNOLOGICAL SYSTEMS, INC., SEABROOK, MD.
Early results from Magsat p0274 A81-48945

C

CALIFORNIA STATE COLL., BAKERSFIELD.
The workshop p0280 N81-32566
Why surface-truth field study is needed in remote-sensing instruction p0280 N81-32567

CALIFORNIA UNIV., BERKELEY.
Use of ocean color scanner data in water quality mapping p0251 A81-43545
Remote sensing aided procedure for conifer growth modeling in the northeastern Sierra Nevada
p0199 A81-43740
Water quality mapping from Landsat digital data
p0252 A81-45429
Users manual for the US baseline corn and soybean segment classification procedure
[E81-10190] p0206 N81-29504

CALIFORNIA UNIV., LIVERMORE. LAWRENCE LIVERMORE LAB.
Remote sensing of soil radionuclide fluxes in a tropical ecosystem
[UCRL-84501] p0219 N81-29517

CALIFORNIA UNIV., SANTA BARBARA.
Satellite detection of oil on the marine surface
p0233 A81-43251
Application of remote sensing for California irrigated lands assessment p0213 A81-43261

CALIFORNIA UNIV. AT BERKELEY.
Application of remote sensing for California irrigated lands assessment p0213 A81-43261

CALIFORNIA UNIV. AT LOS ANGELES.
Geomagnetic field mapping from a satellite: Spatial power spectra of the geomagnetic field at various satellite altitudes relative to natural noise sources and instrument noise
[PUBL-1810] p0275 N81-29480

CANADA CENTRE FOR REMOTE SENSING, OTTAWA (ONTARIO).
Bay of Fundy verification of a system for multidate Landsat measurement of suspended sediment
p0250 A81-43254
Wave orbital velocity, fade and SAR response to azimuth waves p0265 N81-33345

CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE, TOULOUSE (FRANCE).
Scatterometer measurements on crop and soil surfaces
p0208 N81-33349

COLLEGE OF WILLIAM AND MARY, WILLIAMSBURG, VA.
Mineralogical, optical, and geochemical properties of John H. Kerr Reservoir sediment samples for AgRISTARS pollution research
[E81-10155] p0229 N81-33548

COLORADO UNIV., BOULDER.
Mapping alpine soils using color positive and color infrared photographs p0252 A81-46045

COMMITTEE ON SCIENCE AND TECHNOLOGY (U. S. HOUSE).
NASA authorization, 1982, volume 4
[GPO-79-432-VOL-4] p0279 N81-31030

CONNECTICUT UNIV., STORRS.
Modeling the terrestrial hydrology for the global atmosphere - The future role of satellite data
p0245 A81-43197

CORNELL UNIV., ITHACA, N. Y.
Manual versus digital Landsat analysis for modeling river flooding p0252 A81-43745
Manual versus digital Landsat analysis for delineating river flooding p0252 A81-46405
Analysis of landfills with historic airphotos
p0216 A81-46407
Cornell University Remote Sensing Program
[E81-10174] p0255 N81-33560

D

DARTMOUTH COLL., HANOVER, N.H.
An investigation of vegetation and other Earth resource/feature parameters using LANDSAT and other remote sensing data. 1: LANDSAT. 2: Remote sensing of volcanic emissions
[E81-10081] p0209 N81-33543

DEFENSE MAPPING AGENCY AEROSPACE CENTER, ST. LOUIS, MO.
The sensor image simulator
[AD-A101172] p0275 N81-29512

DEFENSE MAPPING AGENCY HYDROGRAPHIC AND TOPOGRAPHIC CENTER, WASHINGTON, D.C.
Interpretation of hydrographic features seen in the waters off Cape Cod
[AD-A102343] p0240 N81-31803
Derivation of shallow ocean bottom reflectance values from color aerial photography
[AD-A101105] p0241 N81-33763

DELAWARE UNIV., NEWARK.
Drift and dispersion studies of ocean-dumped waste using Landsat imagery and current drogues p0233 A81-43539

DENVER RESEARCH INST., COLO.
Space Benefits: The secondary application of aerospace technology in other sectors of the economy
[NASA-CR-164733] p0279 N81-32086

DEPARTMENT OF AGRICULTURE, BELTSVILLE, MD.
Survey of in-situ and remote sensing methods for soil moisture determination p0197 A81-43221
Active microwave measurements for estimating soil moisture in Oklahoma p0199 A81-43744

DEPARTMENT OF AGRICULTURE, HOUSTON, TEX.
Large area application of a corn hazard model
[E81-10164] p0205 N81-28497
Yield Model Development (YMD) implementation plan for fiscal years 1981 and 1982
[E81-10211] p0208 N81-32577

DEPARTMENT OF AGRICULTURE, WASHINGTON, D.C.
Crop area estimation using ground-gathered and sampled LANDSAT data
[PB81-192783] p0207 N81-30507
AgRISTARS (Agriculture And Resources Inventory Surveys Through Aerospace Remote Sensing) DC/LC (Domestic Crops and Land Rover) project summary crop area estimates for Kansas and Iowa, 1980
[PB81-196909] p0207 N81-30511
Crop area estimates using ground-gathered and LANDSAT data. A multitemporal approach: Missouri, 1979
[PB81-186751] p0208 N81-31614
An evaluation of MSS P-format data registration
[E81-10171] p0267 N81-33557

DEPARTMENT OF AGRICULTURE, WESLACO, TEX.
Microdensitometry to identify saline rangelands on 70-mm color-infrared aerial film p0202 A81-46406

DEUTSCHE FORSCHUNGS- UND VERSUCHSANSTALT FUER LUFT- UND RAUMFAHRT, OBERPFAFFENHOFEN (WEST GERMANY).
Introduction to the workshop p0276 N81-33340
Imaging radar systems p0240 N81-33342

M

N

P

Q

R

S

T

U

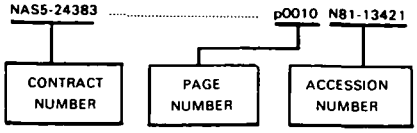
V

W

Z

CONTRACT NUMBER INDEX

Typical Contract Number Index Listing



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REPORT/ACCESSION NUMBER INDEX

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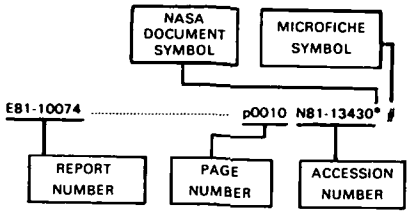

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16. Abstract

This bibliography list 580 reports, articles, and other documents introduced into the NASA scientific and technical information system between October 1 and December 31, 1981. Emphasis is placed on the use of remote sensing and geophysical instrumentation in spacecraft and aircraft to survey and inventory natural resources and urban areas. Subject matter is grouped according to agriculture and forestry, environmental changes and cultural resources, geodesy and cartography, geology and mineral resources, hydrology and water management, data processing and distribution systems, instrumentation and sensors, and economic analysis.

17. Key Words (Suggested by Author(s))	18. Distribution Statement
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